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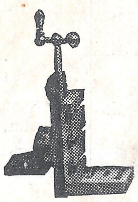

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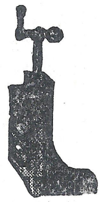

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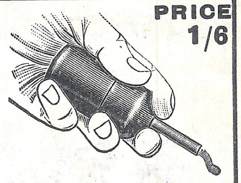

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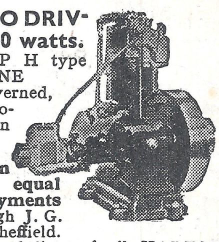

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The
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# SMOKE RINGS

### The S.M. and E.E. Dinner

THE Annual Dinner of the Society of Model and Experimental Engineers, which was held at the Criterion Restaurant, on Saturday, April 4th, proved to be another most enjoyable landmark in the history of the Society. Over one hundred members and friends were present, and among the visitors were Mr. T. Lawson and Mr. Rolls from Nottingham, Mr. Lainson from Southampton, and Mr. W. E. Maddock from Burslem, representing the Stoke-on-Trent Society. Mr. T. N. Gilbert, the President of the Society, occupied the Chair. After the loyal toast of "The King" had been honoured, I had the privilege of proposing the health of the ladies and visitors, a toast which is always given a place of honour at these gatherings. It was acknowledged in an amusing vein by Mr. T. Lawson, who said that if he were not able to be present, he was afraid they would have to abandon the dinner, as this was the fourth successive year in which he had been asked to respond to this particular toast. He said, however, that he had a son who was growing up with the right ideas, so that if in future years he was unable to be present, there would be another Lawson to take his place. The toast of "The Society" was proposed by Mr. L. M. G. Ferreira, Past-President, who referred to the large number of model engineering societies now in existence and said that the Society of Model and Experimental Engineers was really the parent of them all. He thought, however, that there were too many separate units, and model engineering would benefit if some method could be devised for welding these units into a corporate whole. Steps in the right direction might be a change in the name of the Society to the Institution of Model Engineering, the obtaining of the legal benefits of incorporation, and some form of affiliation of the provincial and overseas societies. A development of this kind would do much to raise model engineers in the eyes of the engineering profession and the general public, and so secure a fuller recognition of the excellent work which their members were doing, and could do in times of national emergency. He thought there should not be such a wide gap between amateur and professional model engineers, and the society, in an expanded form, might do a great deal of good in the direction of training young mechanics. Model engineering had outlived the wireless craze which at one time distracted the attention of its followers, and was now going ahead again very rapidly. The Chairman of the Society, Mr. I. C. Cocking, responded, and said that apart from the technical value of the Society's work, membership led to the formation of many much appreciated personal friendships. It was rather surprising how great was the interest in mechanical matters among those who were not professionally engaged in engineering; many of their members were of this kind, and they produced some very fine work. Mr. A. J. R. Lamb, Honorary Treasurer of the Society, proposed the health of "The Chairman," and thanked him for the efficient way in which he had presided over their gathering that evening. He said that Mr. Gilbert was one of the oldest members of the Society, having joined thirty-one years ago, and in addition to his work on the Council he had, for four years, served as Honorary Treasurer. He had the interests of the Society very deeply at heart and was always ready to place his knowledge and advice at their disposal. The toast, having been received with musical honours, was replied to by Mr. Gilbert, who said he much appreciated the complimentary remarks made by Mr. Lamb, who was an old personal friend and rendered valuable service to the Society as Honorary Treasurer. He

was glad to see so many old friends of the society present that evening, and he emphasised the fact that the enjoyment which the members found in their model engineering work was greatly enhanced by the friendship of their fellow-members. He referred to the question of finding suitable permanent headquarters for the Society, and to the subject of incorporation and said that these matters were not being overlooked; there were, however, difficulties in the way which required a good deal of careful consideration. The question of permanent headquarters was a real problem in view of the difficulty of finding a suitable location in a large city like London, which should be reasonably accessible to members, and within the financial means of the Society. The proceedings were enlivened by a capital concert programme, under the cheery direction of Mr. Ivor Richards, and a cordial vote of thanks to Mr. R. W. Wright, the Secretary, for the admirable arrangements he had made for the dinner, and for his efficient work on behalf of the Society, terminated a very delightful evening. On the Sunday following, a party of members and friends journeyed to Brentwood, where they were the guests of Mr. and Mrs. S. W. Simpson, and enjoyed some good locomotive running on Mr. Simpson's track.

* * *

### Mr. James C. Crebbin.

DURING the dinner of the S.M. and E.E. a message of kindly remembrance and good wishes for a speedy recovery was signed by all those present and forwarded to Mr. James C. Crebbin, who is still in hospital following his recent accident. "Uncle Jim" asks me to acknowledge the many kind letters of sympathy which he has received from readers of the "M.E." in all parts, and to say that he regrets he is still unable to deal with correspondence.

* * *

### Guildford Activities.

A CHEERY letter from Mr. E. E. Hughes, the Power Boat Secretary of the Guildford and District Model Yacht and Power Boat Club, tells me of a most useful winter session which has just concluded. Over twenty indoor meetings were held, and the programme included some interesting lectures on model power boat building and on model engineering subjects, such as "The Locomotive," "Files and Filing," "Sand Moulding," and "Edge Tools and How to Sharpen them." These meetings have not only served to keep the members together during the winter months, but much practical knowledge has been gained which will be reflected in the success of the Club boats during the sailing season. This opened at Stoke Park Pond on April 20th, and sailing meetings will be held every Thursday evening and every Sunday morning up to October. Readers in the Guildford area who care to join up will receive a cordial welcome from this happy band of enthusiasts. The Hon. General Secretary is Mr. George E. Jones, 2, St. Mary's Terrace, Mill Lane, Guildford.

* * *

### Passenger-Carrying Track Wanted.

ON June 24th the annual sports day of the Tolworth Central Boys' School is to be held. Mr. R. J. P. Mew is anxious to obtain the loan of a passenger-carrying track and locomotive for this occasion and would be glad to hear from any reader who could co-operate in this matter. The School will pay all expenses. Correspondence should be addressed to Mr. Mew, at The Tolworth Central Boys' School, Surbiton, Surrey.

* * *

### A Durban Exhibition.

AN important model engineering exhibition is to be held in July in Durban, under the auspices of the Durban Society of Model Engineers and Craftsmen. Mr. R. N. MacLean, the Chairman of the Society, writes me that they are particularly anxious to get a good display of model loco. building materials, ships' fittings and power plant, and model aircraft supplies, including I.C. engines, with, if possible, a working example. He tells me that as the Show is to be held during the Durban Winter Season, when "our cousins of the high veld—Johannesburg Pretoria, Bloemfontein, etc., flock down to our semi-tropical beaches to escape the intense cold inseparable from elevations of 5,000 to 6,000 feet, there is every prospect of a good attendance and a corresponding opportunity of business." Mr. MacLean extends a cordial welcome to any "M.E." readers who may be on tour and within reach of the show, and would be glad to hear from any firms who would like their materials and supplies to be exhibited. His address is P.O. Box 552, Durban, South Africa.

* * *

### To Kendal Readers.

NEWS reaches me that there is a desire to form a local model engineering society for Kendal and district. I understand that the offer of a meeting room has already been obtained, and that Mr. C. S. Cowper-Essex is taking the initial steps in getting model engineers together. His address is Keen Ground, Hawkshead, Ambleside, and he would be pleased to hear from any local readers who are interested.

Percival Marshall

# SHOPS SHED & ROAD

## A Column of "Live Steam."

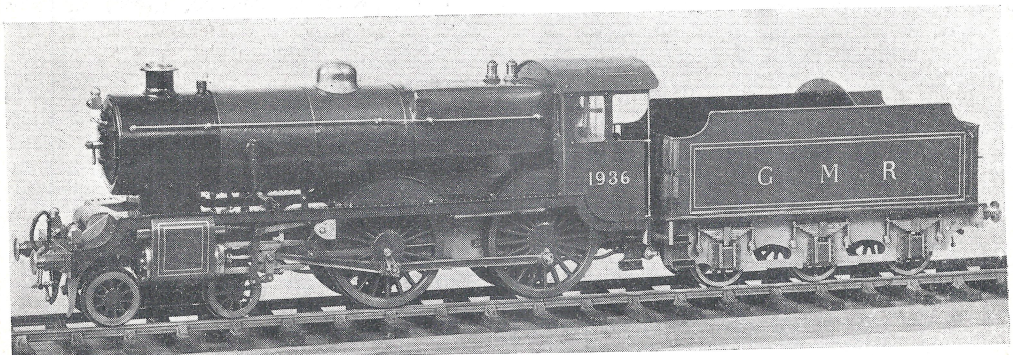
By "L. B. S. C."

**"Annie Boddie" de luxe.**

Here is a picture of a special edition of "Annie Boddie" built by Mr. John Gray, of West Bromwich. Bro. John has got the right name for the start, for nearly ninety years ago another John Gray was locomotive superintendent of the then newly-made L. B. and S. C. Railway, and designed some single-wheelers for that line which proved themselves the fastest runners and the most economical coal burners which the Company thus far had owned. The valve gear was a weird and wonderful contrivance known as the "horse-leg" motion—I'll give a description and sketch if anybody is interested—and needed a good strong driver to notch it up, but it did the job. Our own Bro. Gray's engine is a bit easier to handle, but she also can do the job, so history repeats itself, in a manner of speaking!

The engine is friend Gray's first serious attempt at locomotive building, and is in accordance with the instructions given in back notes, except that some of the "Dyak" details have been incorporated in her by way of refinement. The boiler joints are all Sifbronzed, the job being carried out by aid of an oxy-acetylene blowpipe. The valve gear, which is after the style of the "Dyak's," has forked joints and silver-steel links, hardened and tempered, the pins being left soft. The cab is "Dyak" pattern and has a detachable inset in the roof. A cover is fitted over the lubricator and looks like the end of a middle cylinder. The little engine is fully detailed, and carries the usual blobs and gadgets in the way of lamps and so on. Bro. Gray says he couldn't get any glass-headed pins to use for lamp bullseyes, so he melted up a bit of a broken water-gauge glass in the flame of a Bunsen, and dropped the beads of glass on to the ends of ordinary pins.

The performance of the engine, says John, has exceeded his wildest expectations. At a




"Annie Gray."

off all the time, and would have pulled more but it seemed "cruelty to animals" to overload the tiny bearings too much! I'm not surprised a bit, knowing what the "Annie" sisters will do when they are put to it. The performance of Bro. Bates's edition at the Nottingham Exhibition, when it pulled five adults and made the bigger engines sit up and take notice, was another example. Bro. Gray is now at work on a three-cylinder 3½" gauger, which started as a "Royal Scot" but will be completed as a "Silver Jubilee," and wants to know if I shall be describing any suitable three-cylinder arrangement in these notes. Several other brothers have asked the same question, so we'll see what can be done in the matter; the only trouble is, that never having had a lesson in machine drawing in my life, I'm such a rotten draughtsman that it takes goodness knows how long to get the sketches out, unless I build the engine and copy the actual thing on a sheet of paper!

**Touches—and Touches!**

Our merry old "brass hats" "Smoke Ring" in April 2nd issue was very true. Our radio was going the other evening, and a pianoforte solo came through. It was really lovely; I appreciate good music although unfortunately cannot perform on anything myself—except a locomotive whistle! But it occurred to me at the time, that here was an instrument with what you might term a "competent engineer at the throttle," I forget now whether male or female, but anyway the combination was perfect, and the result excellent in every way. But supposing that same piano was being strummed on, thumped and banged by a small kiddy with neither knowledge of, nor ear for music. What would the result have been? If the discord came to you through the thin walls of a jerrybuilt suburban villa, when you'd come home dog-tired after a day's work, you would not think of that piano as a beautiful

Take another example. Somebody with plenty of dough, but no knowledge or skill, sets up a workshop and stocks it with several hundred pounds' worth of precision machinery and tools. He does not know how to handle either, and kicks off by putting a $3\frac{1}{4}''$ wheel casting in the chuck of a $3''$ high-speed single-geared precision lathe. Said casting happens to be one of those " extra-specials " we happen across sometimes, apparently made of melted-down iron railings, gutter-spouts and other similar scrap, with a few high-speed drill shanks thrown in for flavouring. The operator not only fails to make any impression on the wheel, but practically " does the lathe in " in the attempt, and immediately goes off the deep end about the machine, saying they are cracked up to the nines, but yet are no blankety good at all. He knows, because he's just tried one !

Neither the piano, nor the precision lathe, will do its job unless handled as it *should* be handled ; and the same applies to locomotives both large and small. A " Stanier " engine needs different handling altogether to a " Fowler " or a " Hughes " ; many people (some enginemen included) seem to be under the impression that every locomotive is handled alike, and if anybody can drive one, they can drive the lot. Never was there a more erroneous impression ! Not only different *designs*, but different *classes*, want to be correctly operated to give the best results ; and I'll go farther, and say this much, that, to get as near perfection as possible, *each individual engine* must be fired and driven in its own particular way. Old Billy Stroudley knew that, and so he allocated an engine to each driver, and had the driver's name painted up inside the cab. That was *one* of the reasons why his engines were so successful.

When an engine really is poorly designed and built, however, no amount of enginemanship in the whole wide world will make it do the job. The old adage about not being able to make a silk purse out of a sow's ear, applies in very truth. I know of such engines, both big and little, have had some of the little ones to rebuild, and heartbreaking jobs they've been, at that. Conversely, just the same as in big practice, little engines of track-proved ability have been condemned as " no good " through ignorance, prejudice, or a mixture of both. On rare occasions I get a letter from somebody saying that they have built a " Live Steamer " but it doesn't come up to expectations ; consequently, I'm a—you know what !—and all the rest of it. Never a thought or inkling that the writer of the letter himself is possibly to blame ; if I suggest such a thing, he is usually up in arms in two wags of a dog's tail. For instance, you see above what Bro. Gray's " Annie Boddie " can do, and also what the Nottingham edition did ; yet, not so long ago, I received a very indignant letter, obviously prejudiced, from somebody who had built a similar engine, and said it never had and never would perform as stated ; boiler too small, cylinders too large, and so on and so forth. From the photo enclosed, I could see that the workmanship was O.K., and I took the builder's word that he had set his valves and done all the other necessaries as per instructions, so I wrote him a few " 'ints and tipses " on miniature enginemanship in general, and " Annie Boddie " management in particular. Back came some more vituperation ; " Mr. So-and-so " said she was all wrong, and as he couldn't make anything of her, the said " Mr. So-and-so " *must* be right ; he would be pleased to call and demonstrate, on my own track, what a washout she was. I promptly picked up the flung-down gauntlet, and accepted the challenge, inviting him to bring " Mr. So-and-so " along with him.

The offer was accepted, and a date fixed. " Mr. So-and-so " promptly backed out, but the owner of the engine turned up, with a half-defiant, half-apologetic sort of air. I examined the engine ; and, brothers, what do you think I found ? The firebox was coated with tar all over the inside, five of the seven firetubes were choked, and there was a big " bird's-nest " on the end of the superheater element ! I tried the engine on the pump, and the motion was certainly all in order ; the beat was not quite so snappy as it should have been, but still was quite passable. Thereupon I cleaned out the firebox and tubes, and proceeded to get up steam. In under five minutes from lighting up, there was enough steam to work the blower, and whilst I was disconnecting the electric steam-raising gadget, she ran herself up to 70 lbs. After a preliminary run light, to warm up, I sat on the car and went up and down the track for just on fifteen minutes, only stopping long enough to reverse, and the safety-valve sizzled all the time. I gave the engine about half-a-dozen shovels of coal whilst running.

The water in the tender was getting low, so I stopped, and said to Bro. Impossible, " What about it now ? " He replied that she never went like that for him ; so I refilled the tender and asked him to sit behind me on the car. He did so, and the engine repeated the performance with the double load ; whereupon Bro. Incredulous held out his hand and said, " Friend, I apologise and take it all back. *Will you show me, please, how to drive her ?* " We put a shot of oil in the lubricator, more water in the tender, and he took control. I then explained exactly what to do, and all went off champion. On completion of the run, I showed him how to clean out ready for the next steam-up, gave him a sample of Welsh coal (he had been using ordinary " Derby Brights ") and in the course of a friendly chinwag afterwards, learned that he had, on " advice, received elsewhere," shortened the valve laps and made the cut-off later, explaining that he had been assured that with the early admission and cut-off, the engine would not start unaided. This explained the somewhat dull beat and the extra fuel and water consumption. New valves have since been made as per words and music and the consumption is now normal. There is no need for me to comment on the above, the moral is too obvious.

**" Maisie " (*contd.*)—Boiler Bushes.**

Before fitting the bushes, take a good look over all the brazed seams, and see if you can spot any missed places, pinholes, etc. There

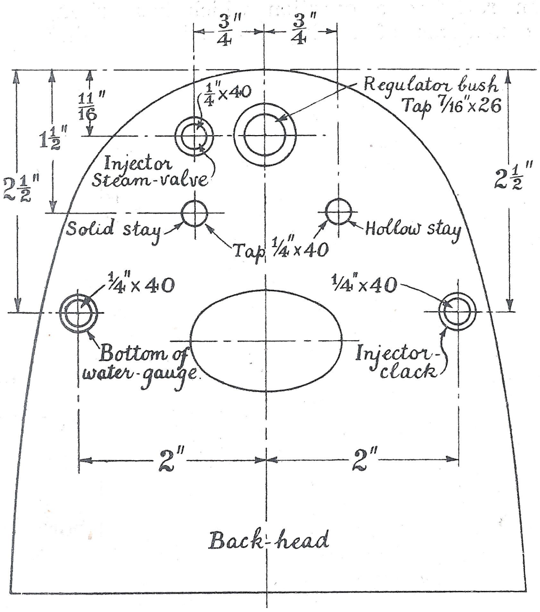
shouldn't be any, if the job has been raised to the proper heat and the brazing metal has flowed freely; but still, there's nothing like making sure. If you find one, mark it, and when the boiler is heated up for brazing in the bushes, a spot of metal can be dropped on it and the defect made good. The bushes can now be fitted, those for the dome and safety valve being made from short lengths of thick copper tube, the former being $1\frac{3}{4}''$ by $\frac{3}{16}''$, and the latter $\frac{9}{16}''$ by $\frac{1}{8}''$. The small $\frac{1}{4}''$ tapped bushes for gauge-glass fitting, injector steam valve, and clack boxes can be made from $\frac{3}{8}''$ by $\frac{1}{8}''$ copper tube, or failing that, $\frac{3}{8}''$ rod, I strongly advise all "L-card" boilersmiths to use copper for bushes, because some of the alloy rod sold commercially, has a melting point very little higher than that of the brazing material; and I've heard of plenty of cases where some poor unfortunate kite, remembering my injunction to have plenty of heat when brazing, has just "overshot the platform" and suddenly found lots of nothing where once there were nicely-turned bushes!

As to the location of the bushes, you don't need more than absolutely necessary, and the sketch shows the location suggested. On the big G.N. type "Atlantics," both feeds are taken in at the backhead, but these are hot injector feeds, and "Maisie" has two extra which are not found on the big engine, viz., eccentric-driven pump and emergency hand pump, both cold. I find that on a little engine, cold water is best fed into a boiler either in the steam space, *a la* G.W., or into the front end of the barrel, and therefore advise sacrificing "scale appearance" to the extent of fitting two clackboxes, one on either side of the boiler barrel, on the centre line about 1″ from the smokebox. Two bushes will be needed for these. On the backhead, bushes will be needed for the bottom gauge fitting, injector steam valve, and injector clack. The stem of the turret, and the elbow for the upper gauge fitting, can be screwed through the backhead flange; and the thickness of this plus the thickness of wrapper, will ensure plenty of hold for the threads without any bushes at all. The regulator bush we have already dealt with.

The bushes should be a tight drive fit in the holes, so they will stay put whilst being brazed. Put a little thin Boron compo. paste around each with a brush. Set the boiler in the brazing pan, there is no need to pack it with coke. Heat up until the compo around the bushes boils off, and then concentrate the flame upon each bush in turn, applying a taste of Cuprotectic, Sil-fos, or best grade silver-solder to each. This will "flash" around the bush at only a dull red, If any blowholes, missed places, etc., have been noted, treat them the same way; dump in the pickle, wash off and clean.

First-time boilersmiths might have a preliminary water test, in case any of their joints prove unsound and needs rebrazing. It is only in very rare instances that such a thing happens, but if a boiler is reheated to brazing temperature after the stays are in and sweated over, umpteen things might happen, e.g., the longitudinal stays might snap like carrots. If your domestic tap is connected direct to the main supply, there will be probably enough pressure for the test; old Brer. Kennion usually tests his boilers that way before staying. Plug up all the bush holes, and connect up the safety-valve bush to the tap by an adaptor and piece of stout hose. A poor joint will start leaking at once. If the main pressure is too low, say under 30 lbs., use a pump, but don't pump more than 40 lbs. at the most into the boiler, or you'll swell out the firebox sides. If all O.K., go ahead with the staying.

Fifteen stays are needed in each side of the firebox, three in backhead and two in throatplate. Make them of 5/32″ copper rod screwed 40 threads, lock-nutted on the inside of the firebox, and riveted over a little outside. Finish the outside heads with a snap if you can, it adds to the appearance as well as strength. The two stays in the throatplate should be put in *parallel with the boiler barrel*, so that the nuts seat properly against the inside firebox. All the stayholes should be




**Bushes and holes on the backhead.**

tapped with a taper tap, the threads in the inside firebox being left a bit on the tight side, so that the stays fit closely, and would probably not leak even if left unsweated. Tip: screw the stays with a die in tailstock holder, well lubricated with Houghtolard-paraffin mixture, and use a dash of same on the tap; this will ensure clean, untorn and well fitting threads. A Terry spanner is the handiest gadget you you could have, for giving the final tighten-up to the locknuts. There are only two longitudinal stays; one of $\frac{3}{16}''$ copper or phosphor-bronze rod with a blind nipple on each end; the other of $\frac{1}{4}''$ by 16 gauge copper tube, with a thoroughfare nipple on the smokebox end, to take the blower union, the rear end being screwed through a tapped hole in the backhead, projecting far enough to screw on the blower valve.

# Lessons in Model Machine Shop Practice.

## IV.—Motion Plate for $3\frac{1}{2}$ in. Gauge "Royal Scot" Locomotive.

(*Continued from page* 324)

THE casting which forms the subject of the present article is an example of work which is generally considered as outside the proper scope of the lathe, and in normal practice would undoubtedly be machined on some tool whose primary function is the production of plane surfaces, such as a milling machine or shaper. Comparatively few amateurs, however, have any other machine tool than a lathe available, and it is, therefore, proposed to show how the lathe may be employed as a milling machine, without the addition of any special attachments, for the purpose in question. The use of a vertical slide, however, would very much facilitate matters, as the main limitation of the lathe in this capacity is the lack of vertical adjustment; but it is by no means indispensable.

In reply to a question which has arisen, the methods of setting up and machining work described in these articles are to be regarded as more or less typical of recognised machine shop principles, which have been known and applied for at least a generation, specially adapted to model engineering requirements. No claim is made to originality, though in some cases the improvisation of measures to deal with the more difficult operations is somewhat unorthodox. Every machinist is occasionally confronted with problems which call for individual initiative; the solution arrived at may not be the very best that it is within human intelligence to conceive, but it produces the desired result with reasonable certainty and accuracy, which is all that really matters.

The casting, which is selected from a set of locomotive parts marketed by Messrs. Bond's of Euston Road, is made in gunmetal, and its peculiar shape and disposition of machined

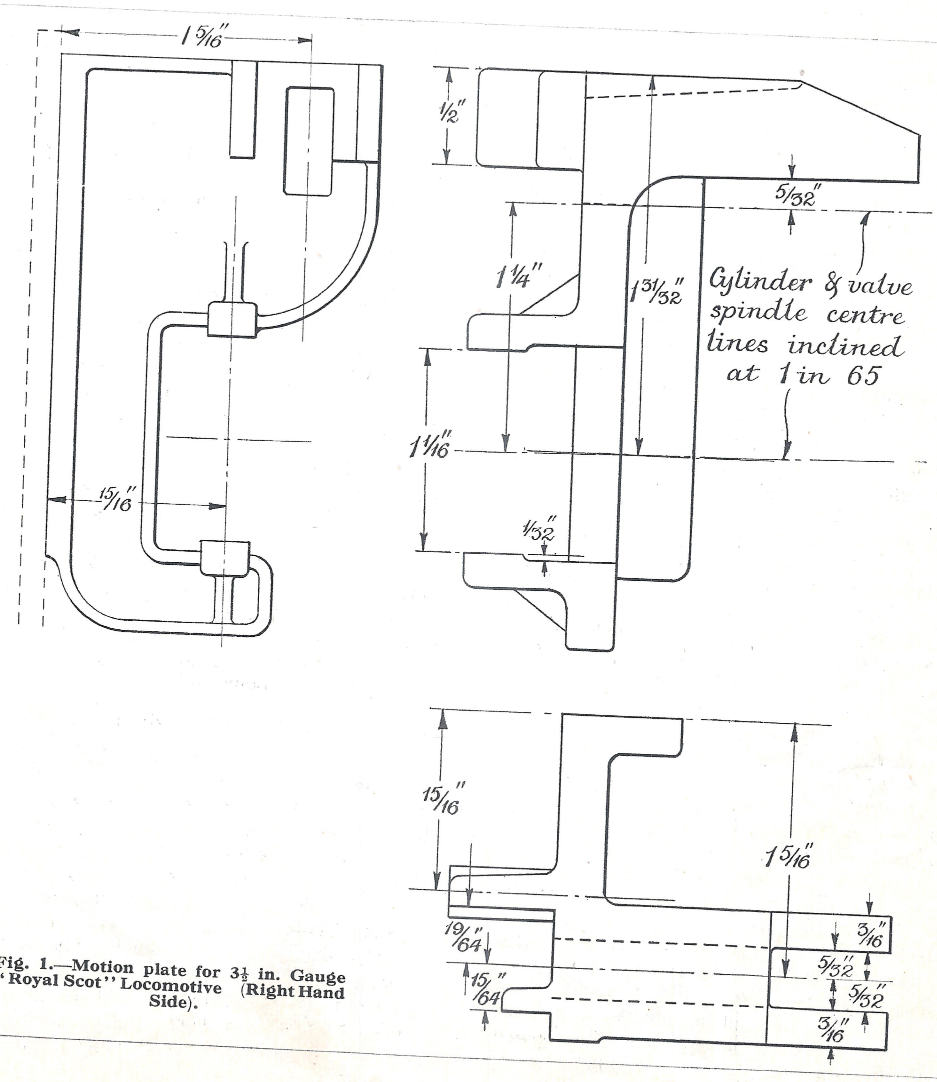



**Fig. 1.—Motion plate for $3\frac{1}{2}$ in. Gauge "Royal Scot" Locomotive (Right Hand Side).**

surfaces present some quite unique machining problems. No doubt many readers, faced with this proposition, would prefer not to machine it at all, but to rely on filing skill in producing the necessary accuracy of the various plane surfaces; there is, however, no question that proper machining methods will very much facilitate accuracy, given the same manipulative skill.

It will be seen from the dimensioned drawing (Fig. 1), that the casting has a flat backplate which is bolted to the locomotive side frame, and a horizontal top surface which fits under the footplate. These surfaces are therefore, at 90° to each other, and present no very unusual machining problems, as they can be produced by facing in the lathe. The surface to which the piston rod crosshead guide bars and the valve crosshead guides are attached, however, are inclined at an angle of 1 in 65 and are also situated so that it would be difficult, if not impossible, to machine them by facing methods.

The first operation required on the casting is, as usual, to produce a true reference face, and the most convenient surface for this purpose is the vertical face by which it is clamped to the frame. This may be faced up by clamping the top horizontal face to an angle plate set on the faceplate, holding it down by dogs over the valve crosshead and gear frame lugs. The top surface should first of all be filed roughly flat, and square with the back frame. When the latter is faced, reverse the casting and accurately face the horizontal top surface, setting the casting square on the angle plate, as checked by a try-square on the two sides.

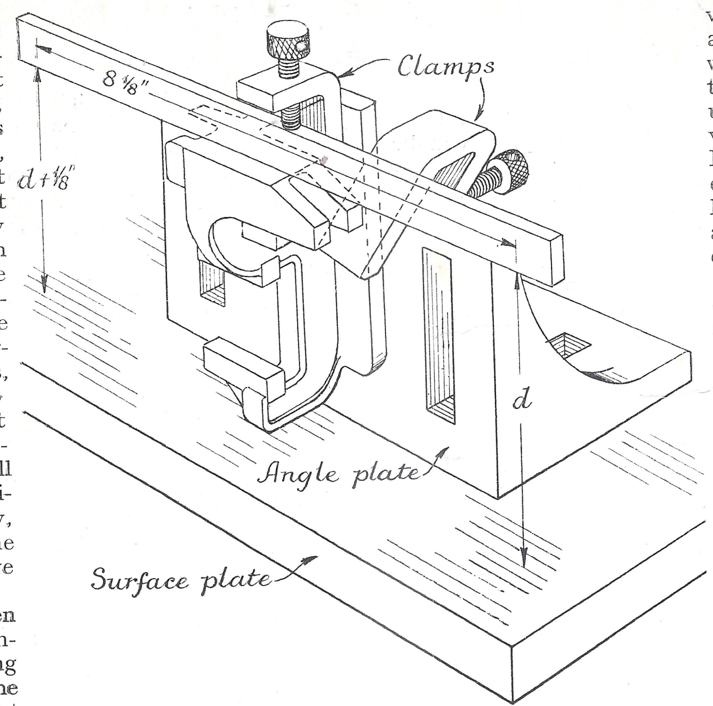



**Fig. 2.—How the correct angle may be determined for marking out the inclined surfaces for guide bar and valve crosshead slide attachment.**

### Marking-Out.

It is now necessary to fix the location of the inclined surfaces of the piston rod and valve crosshead guide attachments. The centre line of the cylinder and piston rod is situated 1 31/32 in. from the top face, as measured at the rear face of the motion plate itself, and the width between the guide bar jaws is 1 1/16 in. In order to mark them out accurately, the jaws should be temporarily fitted with a hardwood filling piece, and the casting set up for marking-out by clamping the vertical face to an angle plate which is set on the surface plate, using any convenient clamps. Lay a straightedge on the top horizontal face, and preferably clamp it thereto, as otherwise, owing to the shortness of this face, there may be some difficulty in keeping it properly in contact when measuring. The taper is set by measurement from the straightedge to the surface at appropriate points; 1 in 65 is equivalent to $\frac{1}{8}$ in. in $8\frac{1}{8}$ in., so that if this distance is marked off on the straightedge, the front mark should be set $\frac{1}{8}$ in. lower than the rear mark. A convenient way of measuring is to use a pair of inside callipers and a slip of material $\frac{1}{8}$ in. thick; any reasonably accurate bar or sheet material will serve. This procedure is shown in Fig. 2.

Having adjusted the casting so that the top face is inclined the right amount, mark out with the scribing block to give the positions of the machined surfaces. Measure from the top face to the piston rod centre line at the rear face of the motion plate, 1 31/32 in., and scribe a centre line on the wood filling; then by means of dividers, measure 1 1/32 in. above and below this point, and scribe horizontal lines by means of the scribing block across the jaws. At a distance of 1 13/32 in. above the piston rod centre line, scribe another line on the valve crosshead lug. Remove the casting from the angle plate and spot out these lines with a small centre punch to ensure that they do not become obliterated.

### Machining the Inclined Faces.

To machine the surfaces thus marked out, the casting may be set up as shown in Fig. 3, on an angle plate bolted to the cross slide, having its vertical face set parallel to the faceplate. Before setting it up, however, true up the front edge of the vertical face dead straight, by filing or otherwise. Clamp a straightedge to the top face, and set it at an inclination of 1 in 65 to the cross slide, as described for marking-out. When properly adjusted, select a piece of flat bar with a good straight edge and bolt it to the angle plate in contact with the front edge of the motion

plate. It thus forms a guide plate which allows the casting to be elevated or lowered on the angle plate without destroying its angular setting, so long as care is taken to keep it properly in contact with the bar.

While it is not possible to obtain the same nicety of adjustment, in this way, as can be obtained with a vertical slide, it is quite serviceable, in the absence of the latter, and will enable the casting to be set so as to be machined to the lines. The valve crosshead guide face will have to be machined with a small diameter cutter, preferably not more than ½ in. dia., so as to allow of cutting a flat surface close up to the radius. The most

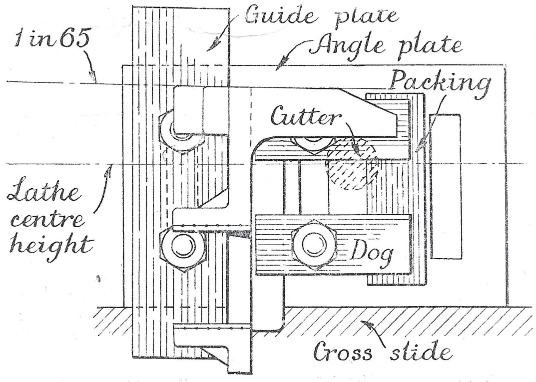



**Fig. 3.—Casting set up on angle plate for machining inclined surfaces.**

suitable form of cutter in this case would be a standard end mill, as these are usually provided with cutting edges on the sides. It is held in the chuck and may be rotated at medium speed for working on gunmetal.

Suitable milling cutters for this purpose may be made from silver steel, as described in the "M.E." handbook No. 41, "Milling in Small Lathes."

The motion plate castings are, of course, right and left handed to suit the two sides of the engine, and, when machining the right hand plate, it will be found that, if the cutter is fed from the rear end of the crosshead guide, it will be liable to snatch badly, through taking up backlash in the cross slide. To obviate this, it is desirable, to feed first of all the cutter in *endwise* at the radius end of the slot and then, by feeding the slide inwards, machine the flat surface from the inner end. Wherever it is possible to do so, milling cuts should be taken by feeding the work in the opposite direction to the rotation of the cutting edge; if the direction coincides, the cutter may drag the work forward up to the limit of the backlash of the feed screw, and the result is a bad dig-in or a broken cutter. Failure to observe this principle is very often the reason why milling in the lathe does not become more popular among amateurs.

Having machined this surface to the scribed lines, or in workshop language, to "split the centre-pops," slacken the clamping dogs and elevate the casting, keeping it in contact with the guide plate, so as to operate on the guide bar jaws. Some readers may favour the use of an exact sized cutter to machine both of these at once, but on the whole it is better to work on them separately, apart from the difficulty of obtaining the correct size of cutter. The same cutter as was used for the previous operation will serve excellently for this one, and can also be used to undercut the jaw along part of its length to form a clearance. Adjustment of cut must be made by partially slackening the clamping bolts and tapping lightly up or down, care being taken to avoid any tendency to shift the guide plate.

### Machining the Valve Gear Frame Lugs.

It is just possible to machine these by clamping the vertical face to the faceplate a good way out of centre, front side outwards, and facing them with a deep side-cutting internal boring tool. This, however, will leave a rounded cut at the shoulder which must be removed by filing, and it is therefore better to again set the casting up on the angle plate as shown in Fig. 4 and mill them with a side and face mill of sufficiently large radius over the spindle to clear the top of the outer lug while working on the inner one. The size of the cutter, however, must not be sufficiently large to risk running into the jaw of the crosshead guide before finishing the cut, and the diameter of cutter shown in the drawing may be regarded as the largest size allowable.

The casting in this case is held mainly by means of a dog across the bottom of the recess between the jaws, as it is too low on the angle plate to allow of holding it over the backplate as in the previous operation. The single dog will be sufficient to hold the casting fairly firmly, but although the grip of the other dog is somewhat precarious, it will help to resist any tendency of the work to swing under the pressure of the cut, as often happens when it is held at only one point.

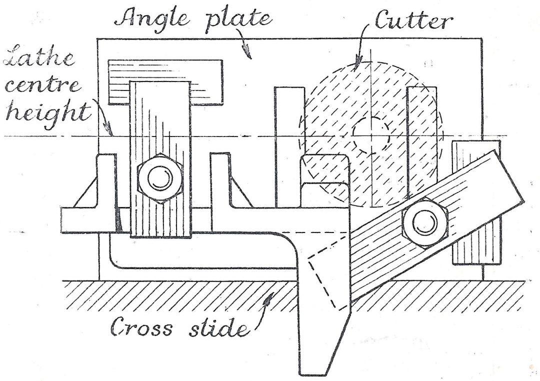



**Fig. 4.—Method of setting up for machining the valve gear frame lugs.**

A milling cutter having only one cutting point, as described in the first instalment of this series ("M.E.," February 27th, 1936) or a similar tool with two or more cutting points may be effectively employed for facing these lugs, providing that the angle at which the points are inserted, and the diameter of the holder, provide the necessary clearance when operating on the inner lug.

There are many readers, possibly some with considerable model engineering experience, who may consider it superfluous to spend so much time and trouble in measuring and setting out exact inclination angles, when it is possible to clamp the motion plate to the frames by a toolmaker's clamp, adjust it by trial and error, and drill bolt holes to suit. It is quite true that this method would, in the present case, achieve the desired result, but there are many cases in which it would not, and the beginner is strongly advised to cultivate exactness as a habit; he will then not be at a loss when a real necessity for it arises.

(*To be continued.*)

# First Steps in Model Engineering.

## Workshop Advice, Experience and Philosophy for Readers of all Ages.

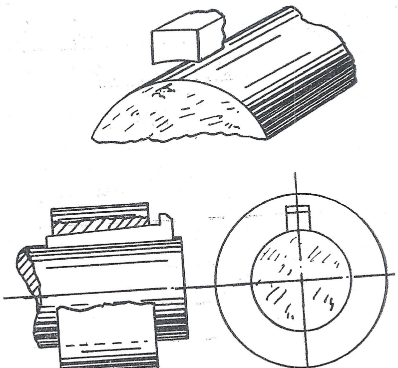
By "INCHOMETER."

**Friction Key.**

The usual term for this is saddle key, the bottom is hollowed to fit the curve of the shaft; sketch G shows the arrangement. An advantage is that the wheel can be moved to different positions along a shaft and fixed without need for cutting a keyseat. A disadvantage is the possibility of slip between shaft and wheel, if the resistance to drive exceeds the friction hold of the key. The arrangement is not adopted for heavy drive, or if a fixed relation of shaft to wheel is an essential condition.

**Sunk Key.**

A longitudinal groove is cut in the shaft, the depth at the sides being half the thickness



G

Saddle Key friction drive : ixing.

of the key. The latter thus engages with the groove cut in the wheel by the other half of its depth. This method gives a strong positive engagement between wheel and shaft, there cannot be any slipping between them unless some part breaks away; sketch H explains the arrangement.

**Key on Flat.**

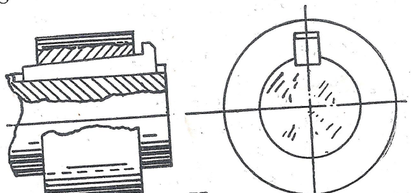
This method gives a strong positive drive and avoids cutting a groove in the shaft. Instead of a groove, a longitudinal flat is filed or cut on the shaft, the breadth being equal to that of the key. Sketch J explains the arrangement.

**Parallel Keys.**

If a wheel, or the like, is to be driven by a shaft, or conversely, but is not to be tightly fixed, a sunk key is used, it has no taper, the top and bottom surfaces are parallel. Examples of this are a lathe motion shaft, or lathe guide screw which also drives a gear wheel sliding along with the saddle; or the keying used for connection of the change wheels with the mandrel, guide screw and intermediate sleeve. The parallel key permits, in the first named examples, the wheel to slide along the shaft, yet be compelled to rotate with it; in the example of the change wheels, it permits them to be easily removed and replaced. The key for this latter purpose is usually sunk into a recess which has dead ends, so that the key will not slide away with the wheel, but remain in its place. With a wheel sliding along a shaft or a screw, the key must be attached to the wheel so that it does not slip away and be left behind when the wheel is moved. Alternative methods of attachment have been devised. the key may be provided with a head at each end, sketch K, so that the wheel is embraced between these; another method is a single head and a screw passing through it into the wheel, or the key may be provided with a stud, some way along its length, which engages with a hole drilled through the boss of the wheel. A parallel key used for the purposes mentioned is often termed a feather. The proportions may be the same as used for a wedge key. A groove, or keyway, cut along the length of a shaft is termed a spline; a splined shaft may have several grooves.

**Fitting a Key.**

The inclined surface for giving the wedge action is always the top surface only of the key, the bottom of the groove in the wheel is sloped to match this. The sides of the key, of the shaft groove and wheel groove are always parallel, and square to the bottom, excepting that a sunk key is sometimes definitely fixed in the groove by caulking, or burring the shaft along the edges, this is to

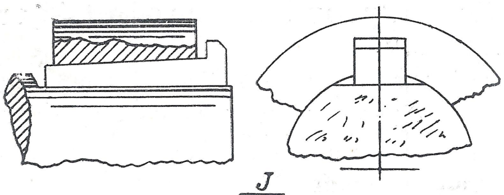


H

Sunk Key drive and fixing.

prevent the key from falling out when the wheel is removed. The flat, or the bottom of the shaft groove, is always parallel with the axis of the shaft, it is never sloped. File (or machine) the bottom surface of the key first, then file the two sides so that they are parallel

to one another and fit easily, but without shake, into the keyway in the wheel, and, if a sunk key, into the groove in the shaft. The two grooves should be of precisely equal width. Put the wheel on the shaft and try if the key slides easily into the two grooves. The sides of a sunk key should, particularly, be an accurate fit in the grooves. The final operation is fitting the inclined face of the key so that it bears evenly against the inclined surface of the keyway in the wheel. Mark the length



J

**Drive and fixing by Key and flat on shaft.**

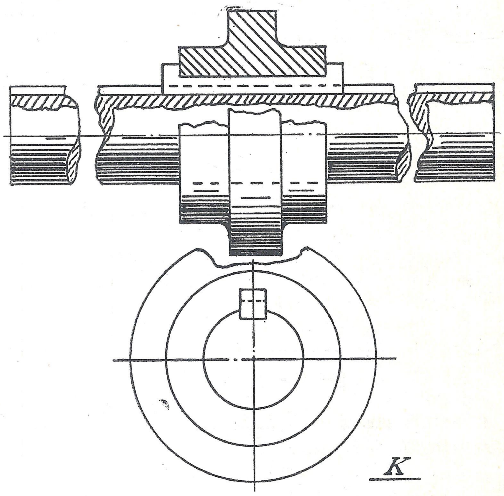
along the key; measure the depths at each end of the combined keyways and apply these measurements at the head and tail ends, respectively, of the measured length on the key. File the surface to meet these depths and try the key into its place. If you knock it in moderately firm and then withdraw it, contact spots will probably show bright. Ease them away by draw filing and try the key in again, and so on until there is reasonable contact shown all over the surface. The key may then be driven in hard. To facilitate investigation of contact, a workshop practice is to smear the surface of the keyway with a thin paste composed of red ochre powder and oil. The key having been driven, and removed, contact places will show by marking. With very small keys, it is not practicable to measure dimensions, you will have to work by trial and observation, but knowing the procedure of fitting a key, will understand the method to follow. Do not drive a key in dry, the surfaces are liable to bind so that there is then difficulty in removing it; smear oil on the surfaces. Very slightly level the edges, do not have them sharp when trying and fitting.

### Making Keyways.

This is a somewhat troublesome matter with small holes and keys such as obtain in model work. In large practice, keyways are cut by slotting, milling, keyseating, broaching and planing machines. Before such appliances were devised, keyways were cut by hand methods, hammer, chisel and file being the tools employed. Even now, such hand methods obtain where machinery is not available. A keyway in a shaft for taking a sunk key may be planed out with a lathe; a parting tool is clamped sideways in the slide rest, the shafts fixed between centres, the tool moved along by the slide, imitating the action of a planing or a shaping machine. It is advisable to drill a shallow hole, diameter equal to the breadth of the keyway, in the shaft, for the tool to cut into at the end of its travel. If it is made to cut against a dead wall of metal, the cutting edge will probably break. When a milling attachment is available, the cutting may be done by a milling cutter, the hole is not then required. Similarly, a keyway may be cut in a wheel by means of an inside tool, the wheel being held in a chuck. The taper can be given by setting the slide to an angle. By hand method the keyway may be cut by means of a file; alternatively it may be cut by means of a saw passed through the hole. If the blade is not thick enough, two or more blades may be clamped together to give the required breadth. Small parallel files, termed "warding" files, are useful for internal keyway work; they are locksmith's files, used for cutting slots in lock keys.

### Proportions of Keys.

There is no definite rule for the amount or angle of taper, the less the angle of slope, the more tightly the key will hold, and the more care and skill needed in fitting. A taper of about one in 100 may be reckoned as a guide, but in model work you will exercise your own judgment. The width of a keyway, and consequently that of the key, may be about $\frac{1}{4}$ to 1/3 the diameter of the hole in the wheel,



K

**Feather Key drive for sliding motion.**

mean thickness of sunk key about 1/6, and key on flat about $\frac{1}{8}$ diameter of hole. A head provided to a key is for convenience in driving in and withdrawal, is necessary for withdrawing when the tail end is not accessible.

## Catalogue of Tool Bargains.

In connection with the closing down of the business of the late George Adams, 290-292, High Holborn, London, W.C.1, a sale of stock is now in progress. We have received an extremely comprehensive catalogue in which we note many bargains in lathes, and in tools or workshop equipment of every description. A variety of woodworking tools, as well as a range of excellent cutlery, is also listed. We think this catalogue should be of considerable interest to all who care to take a rare opportunity of re-stocking their workshops at less than usual cost.

# Electromagnetic Devices.

## With notes on the design of magnets for the model maker and inventor.

By A. H. AVERY, A.M.I.E.E.

THE astrologer and the alchemist in bygone days had a comparatively easy time of it imposing upon a credulous public, and no doubt reaped a correspondingly rich harvest except on occasions when their forecasts went awry. When their black magic failed them, the annoyance caused to some influential client was then apt to lead to a swift and sticky end.

The stars and planets they invoked, and the chemical experiments they dabbled in still remain with us, but are now so much less of a mystery, that the task of the " quack " is far harder nowadays and his public not nearly so easy to delude. Even the most successful of this fraternity now finds it more healthy to indulge in an occasional change of address.

**The First Magnet.**

Although in the light of latter day knowledge, it is easy to make fun of the records of some of these early philosophers, not all of them were quacks, and it seems strange that the marvels of the magnet should have been so overlooked. Whatever knowledge of magnets and magnetism the ancient civilisations of Egypt and the East may have possessed, it seems to have totally disappeared for many centuries. It was not until our English scientist Dr. Gilbert, published his celebrated work " De Magnete " in the year 1600, about the same time that the astronomer Galileo was conducting his experiments with natural lodestones, that public attention was ever directed to such matters.

**Natural Magnets.**

Natural magnets, or lodestones, appear to have been well known and studied even at that time, as Galileo himself had a workshop at Padua where magnetic compasses for ships were made, as well as astronomical telescopes. Even at the present date, there remains preserved at the Tribuna di Galileo in Florence a small lodestone weighing only six ounces, which is shown still supporting in mid air a dead weight of no less than fifteen pounds made in the form of an elaborate iron sepulchre fashioned to represent the fabled coffin of Mohammed. Over three hundred years has this curious casket been hanging firmly attached to the poles of the natural lodestone magnet.

**Earliest Electromagnet.**

The first artificial or " Electro " magnet was exhibited in public one hundred and eleven years ago by William Sturgeon, and caused considerable sensation at the new " discovery." The Society of Arts in 1825 were greatly impressed and awarded Sturgeon a medal and premium. Probably we should regard the performance of this first electro-magnet with some disdain, but it must be remembered that the only source of current at that time was from galvanic batteries. It seems a pity we did not take so much care of this interesting museum piece as its importance justifies, as it appears to have been lost sight of after the Patent Office Museum became defunct. Nowadays, of course, everyone knows the difference between natural and artificial magnets. As the schoolboy remarked in his essay :—" Natural magnets are made by the Almighty, while artificial magnets are made by Man ; the latter are by far the best " !

**Modern Progress.**

The armature to its electro-magnet is " as a limpet to its native rock," as the late Dr. Silvanus Thompson puts it very aptly. The lodestone has but few uses, it is true, now that we know how to produce magnets of so much greater power. Even the so-called " permanent " magnet of hardened steel has enlarged its scope and importance lately owing to the discovery of better magnetic alloys of steel. Also, it is now possible to cast these into different forms without having to bend them from the bar. After machining and suitable heat treatment, they can be magnetised by special magnetising jigs to produce poles wherever required.

**Magnet Steel Alloys.**

Although space prevents more than a passing reference to the subject of permanent magnets, it might be of interest to compare the analyses of those alloys of steel which have been found to give the best results. Roughly, these steels fall into four classes. (1) *Tungsten steels,* containing 5 per cent. tungsten and 0.6 to 0.8 per cent. carbon. (2) *Chromium steels* with 0.24 per cent. chromium and 1.14 per cent. carbon. (3) *Cobaltcrom steels,* having 9 to 14 per cent. chromium, 1 per cent. carbon, and 1 to 18 per cent. cobalt. (4) *Cobalt steels.* These have a far higher percentage of cobalt, varying from 25 to 36 per cent.

An excellent steel having remarkable properties consists of carbon 1 per cent., tungsten 4 per cent., chromium 6 per cent., manganese 1 per cent., and cobalt 36 per cent. It is expensive, but with the most amazing capabilities of resisting demagnetisation, its permanency of magnetisation being unimpaired by treatment which would quickly ruin an ordinary tungsten steel magnet.

**Suitability.**

While permanent magnets have a very wide application to all sorts of mechanical devices, their manufacture and design is beyond the scope of the model maker ; it is a job far better left to the steel makers, as the heat treatment and hardening processes are of quite a delicate nature. But the " permanency " of such magnets is sometimes an unwanted feature, and the electromagnet or the solenoid which can be instantly converted from an inert to a magnetised condition, or vice versa, by the closing or opening of a switch, besides being

a device many times more powerful than a permanent magnet, is often the only possible solution to problems in mechanical design. This is not only the case in matters pertaining to the heavy side of engineering, but particularly to the inventor and model makers' requirements.

**Possibilities.**

Unfortunately, those who are not electrically minded often have the most vague ideas as to what may reasonably be expected from magnetic devices. Often the amateur asks for suitable windings for a magnet or solenoid that is expected to lift an impossible weight through an equally impossible distance, by the aid of a pocket dry battery. Still, magnetism is such a marvellous force that a little haziness as to its possibilities is quite excusable.

Take a couple of small cobalt-steel permanent magnets for instance, and, instead of trying how strongly they attract one another when dissimilar poles are in contact, reverse one of them; they will drive one another apart and on no account will they allow their similar poles to touch without considerable force being exerted. This force of repulsion without any visible cause seems stranger by far than the better known experiment of mutual attraction. Without attempting to account for the exact origin of these effects, the laws that govern them, and the calculation of the correct size, shape and winding, are now far better understood than when Sturgeon's first electromagnet made its appearance.

**Freak Magnets.**

Strange as may be some of the experimental devices out of which efficient designs have grown, few have been more extraordinary than the effort made by Major W. R. King, of the United States Navy, in 1887, to fire 15 inch shells from a 25 ton cannon, converted into an enormous electromagnet by winding on it about eight miles of electric cable excited with

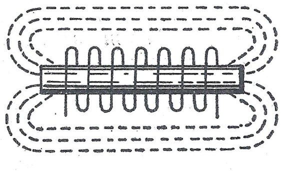


**Fig. 1.—An Electro-magnet.**

current from a large dynamo. The 15 inch shells weighed about 320 lbs. each, but quite contrary to expectations the projectile was only thrown out a few inches beyond the muzzle of the gun when current was switched on, and what was even more unexpected, they returned to the muzzle they had just left and insisted on sticking there so tightly that a force of several tons was required to detach them. Such results, then unforeseen, are easy to account for in the light of later knowledge, since the principles underlying design and winding and magnetic laws in general have become more familiar.

**Classification.**

First of all, it may be asked, what is the difference between a solenoid and an electromagnet? The "Electromagnet" consists of an iron or soft steel core surrounded by an exciting coil of wire, Fig. 1. When current is passed through this coil the iron core becomes a magnet; when the current ceases, the iron core loses its magnetism almost completely. Take away the iron core, leaving only the exciting coil, and our electromagnet becomes a "Solenoid," Fig. 2. But it still acts as a magnet when current flows through the coil, although it is much weaker in its effect than before.

Obviously, therefore, the iron core plays a very important part in the design of all electromagnets, not only in regard to the quality of the iron itself, but depending also upon its shape. Many an ingenious mechanical movement operated by magnets, could have been greatly improved by a better design of the iron core, and perhaps operated by a far smaller current in consequence. The sole idea that must be kept in mind is to design the magnet in such a way that the "flux" or flow of magnetic lines through its core has the shortest and easiest path possible, that is, it must be given as far

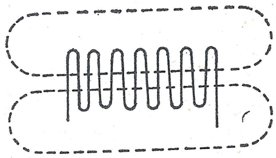


**Fig. 2.—A Solenoid.**

as may be an "all-iron" route. Any airgap or non-magnetic material intercepting the flux introduces a great obstacle to the magnetic lines passing through it, although it is impossible to "insulate" them in the same way that an electric current can be confined to a definite path by surrounding it with a non-conducting material. Of the two, it may be said that it is even more important to study the design of the airgap in a magnetic circuit that it is the iron core. In the solenoid shown in Fig. 2, the whole of the magnetic lines generated by the coil have to pass through air, and this is why it exerts so much weaker an effect with a given current than when an iron core is introduced into the coil, transforming it into an electromagnet, Fig. 1.

**Magnetic Laws.**

There are simple fundamental laws of the magnetic circuit just as there are in the electric circuit. Every electrical student is taught "Ohms Law," which expresses the relationship between the electromotive force (E), which drives the current (I) round any circuit having a resistance (R). A simple way to remember this is to write down the symbols :—

$$\frac{E}{IR}$$

If any two of these three factors are known, the third is then expressed by the symbols remaining after placing the finger over the unknown quantity. Thus, if E is unknown, its value is expressed by :—

$$E = I \times R$$

If I is unknown, its value will be :—

$$I = \frac{E}{R}$$

Similarly if R is unknown, it will be :—

$$R = \frac{E}{I}$$

The magnetic circuit lends itself to the same treatment with its three factors Magnetomotive Force (MMF), Flux (F), and Reluctance (R). Writing these as

$$\frac{MMF}{F\ R}$$

each unknown factor can then be expressed in terms of the other two, for instance :—

$$MMF = F \times R. \quad F = \frac{MMF}{R.} \quad R = \frac{MMF}{F.}$$

Some of these magnetic factors are rather more complex than the corresponding ones in the electrical circuit. The MMF for instance, that force which drives the magnetic lines through their circuit. It is generated by the current which flows through the turns of wire in the exciting coil and is expressed :—

$$\frac{4\pi}{10} \times \text{Turns (T)} \times \text{Current (I) in amperes,}$$

in other words, 1.257 times the Ampere-turns. This force would drive an unlimited flux (F) through the magnet, were it not for the reluctance (R) which opposes it, according to the kind of path they encounter, that is whether the path lies through iron, air, or other material. The condition of the iron also enters very largely into the question, since Reluctance varies, not only with good qualities or otherwise of the iron itself, but also with the degree of magnetisation it has undergone. The greater the number of lines carried by the iron per unit of area the less permeable does it become, and the more nearly in the condition termed "saturated." To sum up, Reluctance depends directly upon the length of the magnetic circuit (l) and inversely as its area (A) and its permeability ($\mu$) for the time being, this varying as the degree of saturation or "flux-density." Reluctance may therefore be expressed as :—

$$R = \frac{1}{A \times \mu}$$

To complete the relationships between MMF, F, and R in a simple formula :—

$$\text{Flux} = \frac{MMF}{R.} \quad MMF = \frac{4\pi T\ I}{10} \quad \text{and } R = \frac{1}{A \times \mu}$$

$$\text{therefore Flux} = \frac{\dfrac{4\pi T\ I}{10}}{\dfrac{1}{A \times \mu}}$$

All this, of course, is to be found more or less in every text book, and may not be very interesting to the reader, but one is brought up against these facts so constantly when trying to design any magnet or solenoid that they cannot be ignored; it will help immensely to appreciate their significance.

**Permeability.**

Before one can get much further, it is clear that the question of permeability ($\mu$) must be looked into a little more closely, in order to find how far it affects the reluctance of a magnetic circuit which is otherwise fixed by

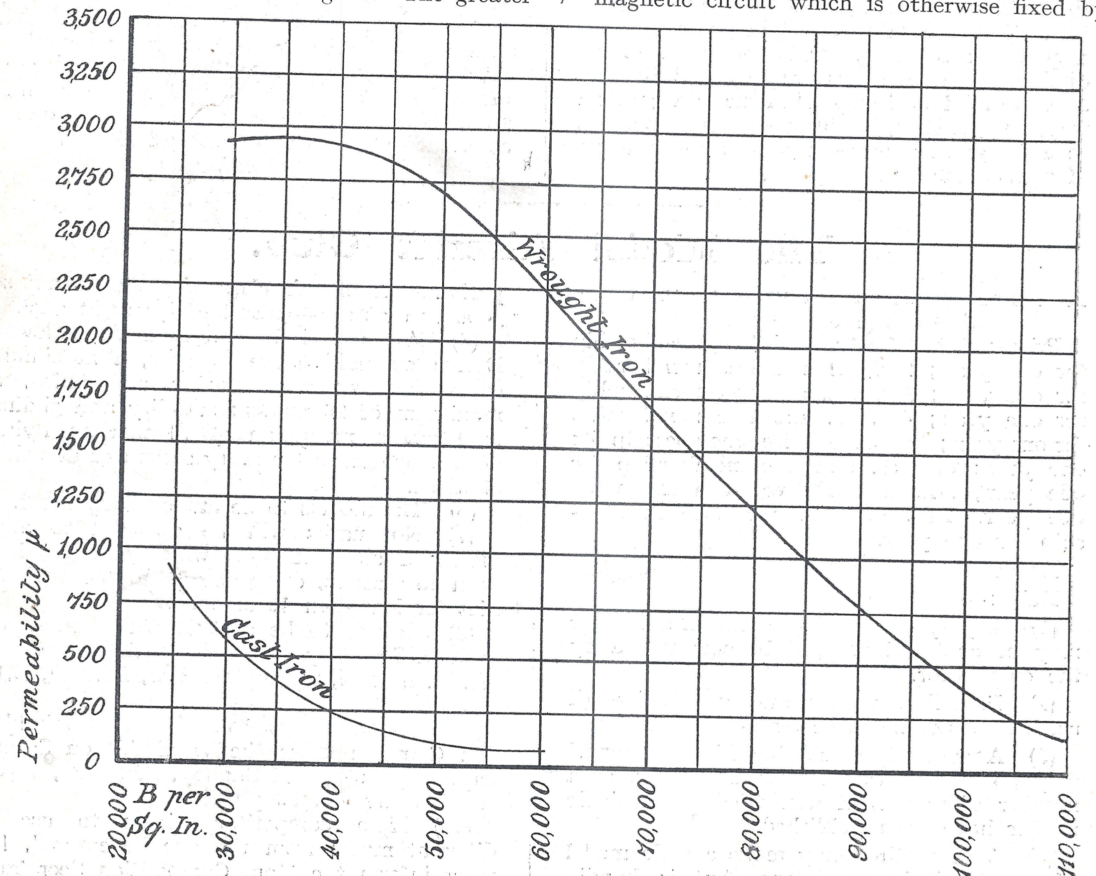



**Fig. 3.—Permeability Curves of Wrought and Cast Iron.**

its mechanical dimensions. Lengths and areas are easily arrived at by direct measurement; permeability, however, is a variable and must be ascertained from reference tables supplied from test curves generally provided by various iron and steel manufacturers.

Such materials as mild steel and its alloys show a very distinct difference in their response to magnetisation as compared with cast iron. There are many different grades of iron and steel, but for model making purposes, the characteristics of an average grade of each material will suffice for ordinary magnetic calculations. Characteristic curves of permeability will be found in Fig. 3, to which reference will frequently have to be made; the magnetising force and the resulting magnetisation in steel and cast iron are here plotted out in the form of curves, and at once show how much more readily mild steel responds than cast iron. A simple coil of wire, such as Fig. 2, carrying a current generates a certain number of magnetic lines according to the number of ampere-turns per unit of its length. This number of lines, or flux, will be enormously increased if an iron or mild steel core is inserted in the coil. In other words, the iron has a "multiplying effect" upon any flux which is due to coil effect alone. But the extent of this multiplication is not constant, it depends upon the flux-density or number of lines per unit area that are at the time present in the iron core. At first this multiplying increases faster than the magnetising force or mere ampere-turn effect, but after a certain point the iron responds less freely and its permeability diminishes more or less rapidly. Both cast iron and mild steel respond in the same general way, but the steel, it will be seen, is responsive to a far greater degree for the same amount of applied magnetising force.

The moral to be learned from this is that mild steel or soft wrought iron should always be used for magnet cores in preference to iron castings, when the design permits. To calculate the dimensions of a magnet for a particular strength, it is necessary to know the flux density at which the iron core can be worked, because the calculation of the magnetic reluctance depends largely upon this. If (H) magnetic lines are produced by the coil in air alone, and (B) lines result from the insertion of an iron core in the magnetising coil, as shown by the curves in Fig. 3, the relation between the two is:—

$$\frac{B}{H} = \mu$$

The possibilities of making an actual calculation of the strength of the magnet are now coming into sight, since its dimensions can be measured, the number of turns in the exciting coil can be counted and multiplied by the amperes passing through them. Fig. 3 gives the remaining clue required to ascertain the reluctance of the whole magnetic circuit, and when once this is known, the flux (F) is easily calculated.

**Flux Density.**

In order to avoid the time wasted in trying to design magnets of impossibly small dimensions for the work they have to do, it is well to realise at an early stage that the magnetisation of iron ar steel can only be carried out economically up to a certain point. This is more or less obvious from a study of the permeability curves in Fig. 3. The response of the iron to the magnetising force in its early stages is so much greater than at a later period, that it is obviously a waste of energy and material to try and push the magnetisation very much higher, when the permeability has already fallen so low that it lends little or no assistance naturally to the final results.

*(To be continued.)*

# The Model Aircraft Club.

**A Construction and Flying Contest for Juniors** (under 16 years).

Prizes: 1st, £1 10s. and free membership for one year; 2nd, £1 and free membership for one year; 3rd, 10s. and free membership for one year; 4th, 5s. and free membership for one year; 5th, 5s. and free membership for one year; 6th, 5s. and free membership for one year; 7th, 5s. and free membership for one year. Also five prizes of free membership for one year.

No entrance fee.

Rules:—

(1) Any type or design of model aeroplane may be copied, but must be constructed by the competitor.

(2) Propeller, wheels and gear drive (if used) need not be made by the competitor.

(3) A competitor choosing his own model may do so, but we do not advise this, as a number of designs of well tried and reliable models have been published.

(4) A competitor may make a scale model of some full-size aeroplane, but is handicapping himself in doing so, as the flying performance of this class of model is not so good as that of the standard type of model.

(5) Marks will be awarded as follows: Design or resemblance to type, a maximum of 50 marks; workmanship and finish, a maximum of 25 marks; stability and gliding qualities, a maximum of 10 marks; flying points, one mark for every second of duration of flight.

(6) The models to be launched by hand.

(7) No marks will be awarded to any model of standard type which flies for less than 15 seconds, or to any scale model which flies for less than 10 seconds.

(8) Entries to be sent to the Hon. Competition Secretary of the Model Aircraft Club, Mr. H. Fialko, 31, Whites Row, London, E.1, not later than April 30th, 1936.

(9) The contest will take place on Wimbledon Common (near the Windmill) on Saturday, May 30th, and Sunday, June 7th, 1936, commencing at 3.30 p.m.

(10) If a competitor wishes to use a different model from the one he entered, he must inform the Hon. Competition Secretary at least two weeks before the contest.

# LOCO. PROTOTYPES NEWS and NOTES

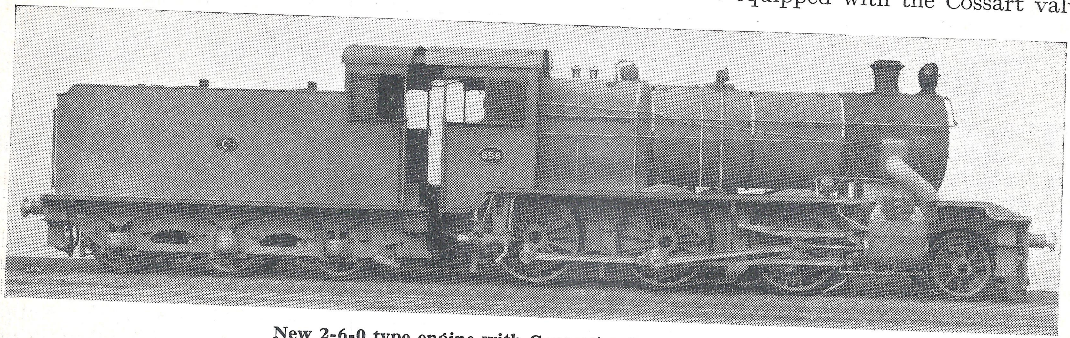
By CHAS. S. LAKE, A.M.I.Mech.E., M.Inst.L.E.

## New British Built 2-6-0 Type Engines for Egypt.

An order for 50 2-6-0 type engines and tenders was placed last year with the North British Locomotive Co., Ltd., of Glasgow. These engines, one of which is illustrated herewith, are specially designed for light axle loads. Thirty of their number are fitted with Walschaert valve gear and piston valves, and the remaining twenty with Caprotti poppet valve mechanism, the one shown being of this last named kind.

The boiler barrel is slightly tapered and is fitted with a Belpaire pattern firebox; superheating apparatus and rocking firegrate. The cylinders are $17\frac{3}{4}$ in. diameter by 28 in. stroke, coupled wheels 5 ft. $6\frac{3}{4}$ in., and truck wheels 3 ft. $8\frac{3}{4}$ in. diameter. Wheelbase, coupled 14 ft. 9 in., and total 23 ft. $11\frac{1}{2}$ in. Total heating surface, including superheater, 1,656 sq. ft., grate area 25 sq. ft., and boiler pressure 225 lb. per sq. in.

The engine, in working order, weighs 63 tons, and the tender, with 3,700 gallons of water and 6 tons of coal, $43\frac{1}{2}$ tons, a total of $106\frac{1}{2}$ tons. At 85 per cent. of the boiler pressure, the tractive force is 25,270 lb. and the factor of adhesion 4.52.

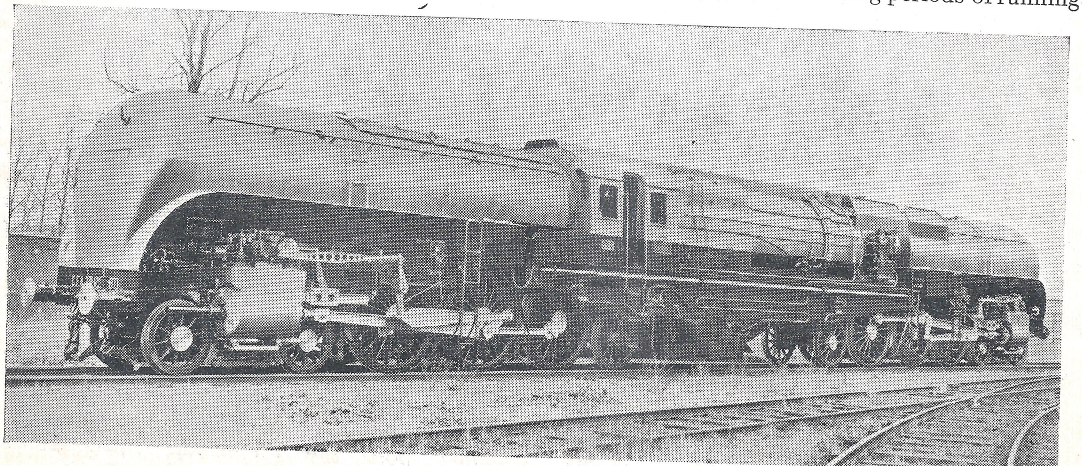


New 2-6-0 type engine with Caprotti valve gear for Egypt.

## A Super-Garratt Locomotive for Algeria.

There has been completed at the works of the Société Franco-Belge de Matériel de Chemins de Fer, at Raismes, France, the first of a series of twelve very large and powerful Beyer-Garratt express locomotives specially designed and built for service on the main lines of the Algerian Railways, and the writer was recently afforded an opportunity, at the invitation of the builders, to inspect the completed locomotive and others in course of construction at their works.

The wheel arrangement, as the illustration reproduced shows, is 4-6-2 + 2-6-4. Semi-streamlining has been resorted to and the locomotive is equipped with the Cossart valve mechanism with vertical piston valves, in which the valves and cam gear remain stationary whilst the engine is running with steam shut off. Electric motors are employed for reversing the valve motions of the four cylinders, and this is operated by a small lever in the cab which can be adjusted, on the "infinitely variable" system, to the most minute points. These arrangements make it possible for the engine to work at a very early cut-off, and it is anticipated that this may be as low as 5 per cent. for long periods of running.



New Super-Garratt semi-streamlined locomotive, built in France for the Algerian Railways.

The four cylinders each measure 19¼ in. diameter by 26 in. stroke, and with twelve coupled wheels 5 ft. 11 in., and a boiler pressure of 284 lb. per sq. in., this represents a very powerful design. The boiler, though relatively short as is customary and, indeed, one of the advantages of the Garratt system, has a large superheater area, there being 48 superheater elements. The chimney is of the double pattern with variable blast pipes. Improved braking is one of the features of the design, this being now 66 per cent. of the adhesion weight as compared with 54 per cent. in the case of the previous large Garratt passenger engines for the Algerian Railways. All the wheels of the engine except those of the bissel trucks, i.e., the inner wheels, are braked. Mechanical lubrication is carried out on a wider scale than is usual in most locomotives, being applied not only to the cylinders and axleboxes, but also to such parts as the slidebars and, of course, to the pivots and other special component parts used in the Garratt as compared with an ordinary locomotive. The total weight of the engine is 212 tons 8 cwts., and the total heating surface with superheater 3,469 sq. ft., with grate area 58 sq. ft. The tractive effort is 58,102 lb. at 75 per cent. of the boiler pressure. The engines have been designed to run safely at 75 m.p.h. on the level and on curves over 2,460 ft. They can also run over curves of 656 ft. radius at 31.1 m.p.h. without danger. They are capable of taking trains of 640 tons on gradients of 1 in 50 at 12½ m.p.h., and trains of 443 tons at an average speed of 62.1 m.p.h. on a continuous incline of 1 in 286.

The writer, during the trials held in France, was particularly impressed by the smooth running of the locomotive, the manner in which it accommodated itself to the variations of the track, and the very rapid acceleration. The cab is commodious, and the reversing of the locomotive so easy and simple to effect, that it appeared to be not so very far removed from the adjustment of an ordinary wireless set.

# The Levant Engine Preservation Fund.

THOSE who appreciate the part Cornish engineers played during the 19th Century in contributing so much to mining progress and to the development of the steam engine, will learn with pleasure that the effort to preserve the 100-year old Levant engine has been successful. The engine has been purchased, and will be kept in a state of preservation in its own engine house, perched on the edge of cliffs which are unsurpassed for grandeur in the British Isles. Levant and the adjoining Botallack mine were famous for their richness in copper and tin, and for their deep workings which extended far out under the Atlantic ocean.

Gratitude is due to those who have subscribed to the appeal for funds, those who have helped by giving the project publicity, and to Colonel Robyns who has leased the engine house to the Committee for a small acknowledgment rent.

It is interesting to note that apart from generous support from the Falmouth Docks Co., Climax Rock Drill Co., Messrs. Holman Bros., the learned institutions of Cornwall and a few public spirited Cornishmen, the greater part of the subscriptions, which amounted to £130, have come from beyond the Tamar. The members of the Newcomen Society; the Institution of Civil Engineers and the Institution of Mechanical Engineers contributed freely. Cheques and encouraging letters have been received from Calcutta, California, Egypt, Shanghai, Rhodesia, Melbourne, Ashant and Malaya.

It has been very encouraging and reassuring to have attracted the interest of such men as Dr. H. S. Hele-Shaw, a Professor of Engineering, who, in the letter which accompanied his subscription, said :—

"I have always, as a Professor, laid great stress on the value to the trade of this country of the pioneer work of the steam engine in Cornwall, and I am delighted to think that some Cornishmen have got the public spirit to save at least one of the original engines *in situ*, especially in such a beautiful situation."

Professor J. S. Dines, of the Air Ministry, has written and stated: "I have recently returned from Cornwall and noted with pleasure the success which has been achieved with the Levant engine scheme, and I now wish to contribute a sum of £50 towards the completion of the bigger project of preserving some of the larger pumping engines in the Redruth-Camborne area." This offer will be accepted when the Cornish Engines Preservation Committee feel satisfied that sufficient public interest and support will be forthcoming to proceed with the bigger scheme they have in view.

In addition to the preservation of Cornish mining machinery, it is very gratifying to report that arrangements are being made to complete the model of the 90-inch pumping engine which was taken in hand by the late Mr. Oswald Swete, of Truro. Mr. Swete was a mining and mechanical engineer, and was also a very enthusiastic and skilled model maker. At the time of his death, he had partly completed a working model of Taylor's pumping engine, which is at East Pool Mine. When completed, this model will be associated with Mr. Swete's name, and kept in a County institution.

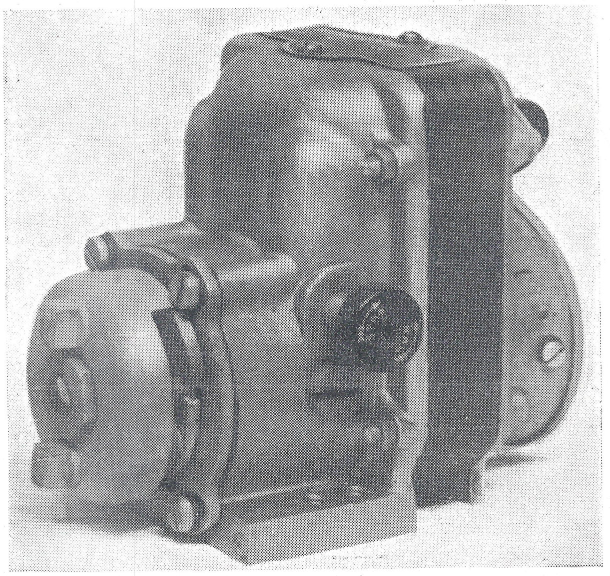
One of the prized exhibits of the Science Museum at South Kensington is a three-inch model of the celebrated 85-inch Taylor's engine, which was formerly at the United Mines. One hundred years ago the people of Cornwall, one and all, subscribed to a fund for the erection of a monument on Carn Brea, to Lord de Dunstanville; it will be still more to their credit to preserve one or two Cornish engines as a memorial to the engineers and miners of the Duchy.—W. TREGONING HOOPER, Falmouth Observatory.

# New Tools and Supplies

## Magnetos for Small I.C. Engines.

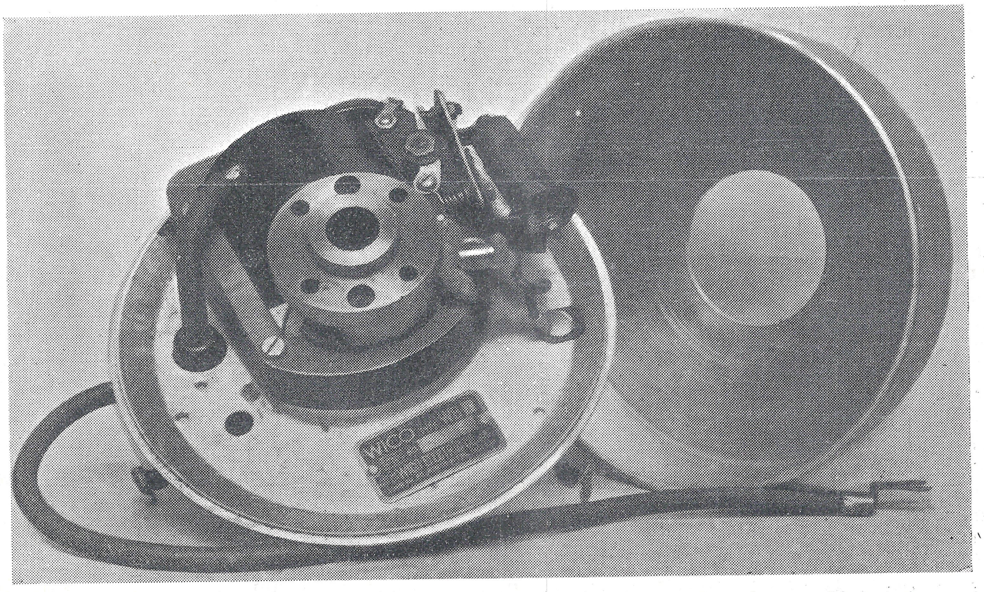
The efficiency of the ignition equipment is of vital importance to the success of all internal combustion engines, from the largest to the smallest, and in the latter case, the limits of size and weight call for special treatment of this problem. There is no question of efficiency and reliability of all modern high tension magnetos, but conventional principles in their design have generally made them very costly to manufacture. A range of light magnetos recently brought to our notice, however, embody some ingenious principles in design which enable them to be produced comparatively cheaply, while retaining the inherent advantages associated with magnetos generally.

These products are manufactured by the Wico Electric Co., Ltd., Sunbeam Road, Chase Estate, Acton, London, W.10, who have for many years been associated with the production of magnetos for large industrial engines. This particular type of magneto, known as the "EK," has special points of interest, as the armature windings are stationary, and there is only one moving part, which is reciprocated by a trip rod from the engine camshaft. The smaller rotary magnetos introduced in recent years, however, are more particularly applicable to small engines, being light and compact, and fully reliable. They also have stationary windings, but are excited by a magnetic rotor comprising two cobalt steel bar magnets with laminated poles, revolving in an enclosed magnetic circuit on the centre limb of which the primary and secondary windings are situated. The action of the ordinary magneto is thus produced in identical effect by the reversal of the moving and stationary parts, but with the advantage that the contact breaker design is simplified, there are no rotating brushes or slip rings, and much better enclosure and protection of the electrical parts is possible. The type "LD" magneto, built on this principle, is made either for single-cylinder or multi-cylinder engines, and may be fitted with an impulse starter, which ensures a high efficiency spark at the lowest rotational speeds.

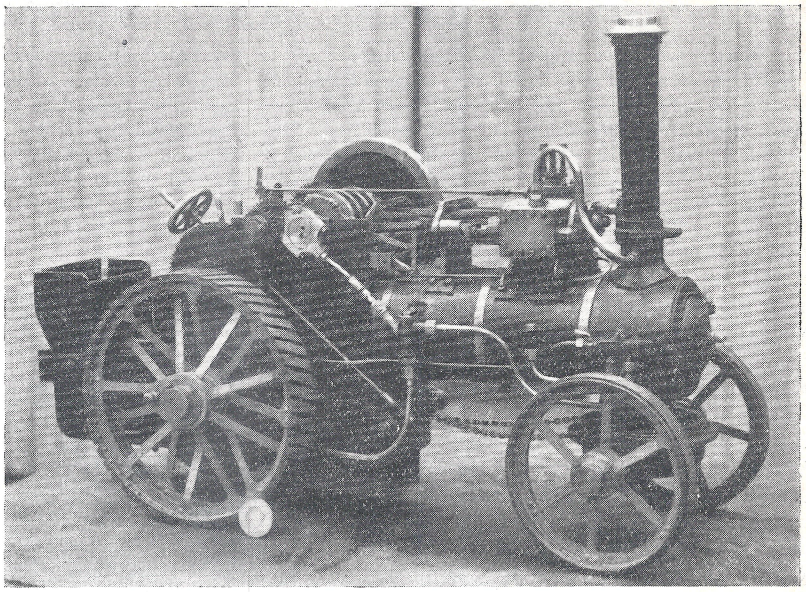


The Wico type "LD" rotating magnet magneto, for single cylinder engines, fitted with impulse starter and switch.

An even more interesting magneto, in view of present tendencies in small engine design, is the type "WB," in which the identical



The Wico type "WB" magneto, with actual flywheel and cover removed to show working parts.



Photograph of 1¼" scale Model Traction Engine.

magnetic circuit described above is employed in a flywheel (or more correctly, engine-shaft mounted) magneto, providing the utmost compactness, and freedom from any potential trouble or loss of efficiency associated with any form of transmission gear. The rotating magnet is not actually a part of the flywheel, and thus the latter does not need to be made of a non-magnetic material, as is usual in this type of magneto.

Both types of magneto have already earned an excellent reputation, proof of which lies in the fact that they are now fitted to engines made by firms such as Messrs. Stuart Turner, and other "M.E." advertisers. Any readers who are contemplating building a small workshop engine, or converting an engine from coil to magneto ignition, would do well to investigate the possibilities of Wico magnetos.

### A 1¼ in. Compound Traction Engine.

The accompanying photograph shows an excellent model traction engine built by Mr. E. G. Cole, of Braintree, from the castings and parts marketed by Mr. A. J. Every, of 27, Elder Place, Brighton, 1. The engine is to 1¼ in. scale, and with a boiler pressure of 50 lbs. has hauled a load of 29 stone. It is fitted with a feed water heater, which supplies the boiler constantly with really hot water so that no loss of pressure is apparent when filling.

# For the Bookshelf.

**Steam Locomotive Design: Data and Formulae.** By E. A. Phillipson, Assoc.M. Inst.C.E., A.M.I.Mech.E., M.I.Loco.E. (London: The Locomotive Publishing Co., Ltd.) Price 30s., postage 6d.

This book, which should find a ready welcome among all who are, in any way, associated with Steam Locomotive design, is aptly described by its title. It forms, as it were, a buffer between purely elementary principles and highly academic theories, and is—as the author states in the Preface—an anthology for the locomotive engineer. The historical aspect is completely ignored, with a few minor exceptions, the author having contented himself by presenting the subject of Locomotive Design as it is; not as it might have been, or ought to be. No discussions on controversial or debatable points are attempted; and, although the author is a professional locomotive engineer, his text is remarkably free from purely biased commentary. He is to be congratulated upon having collated an immense amount of technical data and formulae; and, in each case, the reasoning, which has given rise to the existence of such data and formulae, is clearly set out.

An immense number of line drawings, pertaining to every detail of locomotive design, illustrate the text. In addition, there are twenty-seven folded plates, reproduced from drawings, all, except two, of which are highly satisfactory. The two exceptions are general arrangements of modern British Express Passenger locomotives; in these two instances, the utility of such drawings seems to us to be rather doubtful, owing to the wealth of detail, much of it in dotted lines, having become somewhat obscure, due to its complexity combined with over-reduction. We are inclined to the opinion that even the large-scale original drawings, from which these reductions were made, must be difficult to follow, and of somewhat doubtful utility.

Nevertheless, the illustrations in this book are invaluable, not only to professional locomotive engineers, but to model-makers, who will find here illustrations of details, information of which is usually extremely difficult to obtain, and the author's explanatory remarks in the text are always helpful.

In our copy, the photogravure frontispiece is of very poor quality which we hope is not general throughout the entire edition.

We are informed that the price of this book may be remitted in six monthly instalments of 5s. each.

# MODEL MARINE NOTES

## A Device for Stopping Speed Boats.

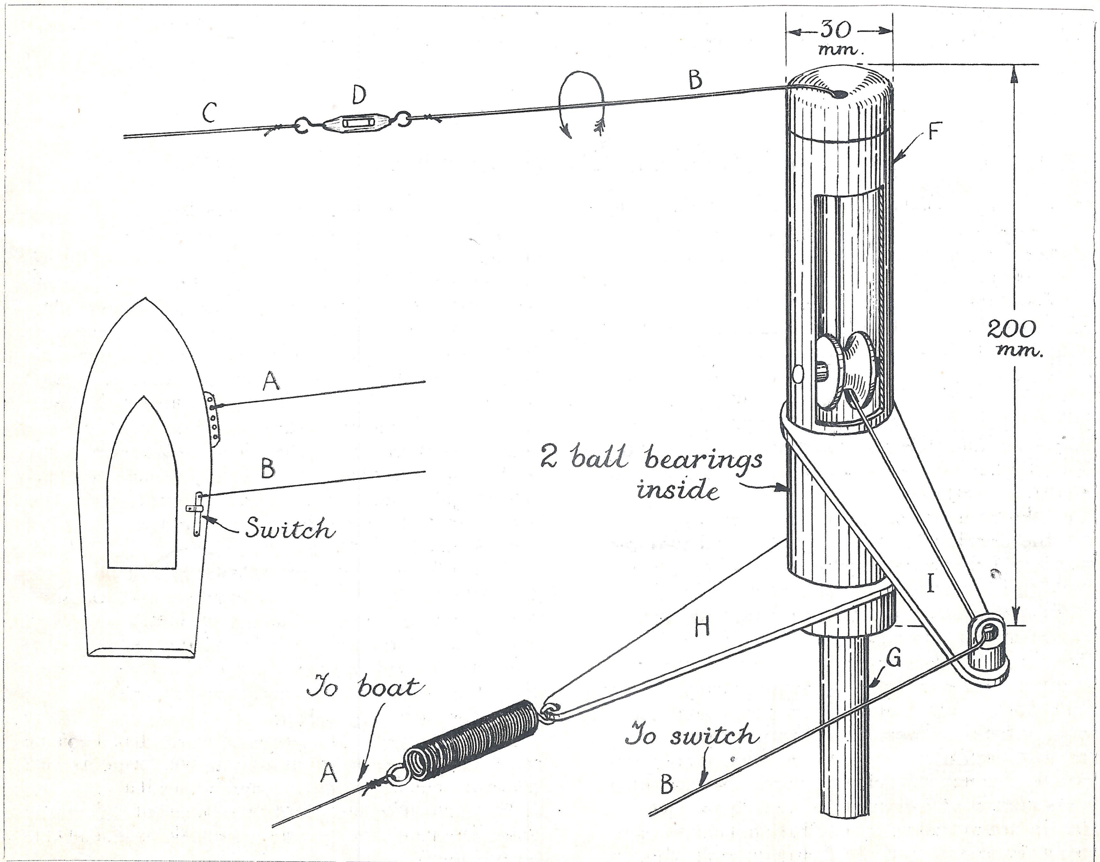
**By G. M. SUZOR (of Paris).**

I HAVE some sad news to report to you—the motor of Nickie V is dead. The accident occurred on Sunday, March 22nd, during an attempt on the record; on the third run when the speed was becoming good, the "big-end" gave out and the piston became completely burnt. I am, therefore, obliged to make a new crank-shaft, a piston, and a new cylinder, which will be of a new design. This will take me some time, but I shall do my best to be ready for the next International Regatta at London. I can then tell you some more about it.

During that unfortunate day we have experimented with a new method of stopping the boats without touching them, the operator being on shore. I give a sketch in explanation. The piece F, fitted with ball bearings, turns freely on the pivot of the pole G. This piece carries two arms H and I about 15 centimetres apart. At the extremity of the arm H is fixed the cord A which tethers the boat; through the extremity of the other arm I there passes a cord B which, starting from a switch on the boat, passes out through the upper end of the piece F to reach the hand of the operator. It will be seen that in order to stop the boat, the operator has only to give a sharp tug on the cord C to pull off the switch on the boat. As at the point B the cord is liable to twist, the swivel D (a fishing accessory) is inserted which permits the cord to revolve freely.

This device has worked with a wire A in steel, and an ordinary cord B, separated from one another by about 15 centimetres to avoid their getting entangled. It is also necessary that the switch should be sufficiently stiff in working to support the weight of the cord B, without being pulled "off." It is further necessary to use a steel wire A, for the ordinary cord stretches too easily. and varies in length so much that the regulation of the cord B becomes too delicate.

As described, the system works very well, and I offer the idea forthwith to my English colleagues so that we may each endeavour to perfect it. Its advantages are as follows: It often happens that during the trials a rowing boat approaches the running circle too closely, and is in danger of a collision with the speed



boat. With my system it is easy to avoid the accident. On a regatta day, much time is lost whenever a competitor finishes his run, for a boat has to be put out to recover the speed boat, which always stops in the middle of the lake. With my system, one can stop the boat a few yards before its owner catches it with his hands without loss of time.

I have been asked over here why I did not use an electric control, but in reply to this I would say that on the one hand the boats would have to carry an accumulator on board, or on the other hand, a good double electric conductor of 15 metres in length would be much too heavy.

As regards the steel wire which tethers the boat, I have heard it said by my friend Mr. Innocent, that a steel wire makes the boat unstable, and liable to turn over. But, as against this, in order to avoid the troublesome stretching of the ordinary cord, which automatically reduced my world's record of September 23rd, 1935, I resolved to experiment myself, and I am able to say that I have not observed the trouble indicated by Mr. Innocent. I have experimented with a safety spring, but without the spring the steel wire seems to me to be perfect. If the weight would not be a difficulty, it would be desirable also to make the cable B in steel.

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# QUERIES and REPLIES

**Querists must comply with the Conditions and Rules given with the Query Coupon in the Advertisement Page of each issue.**

**6,995.—Accumulator Acid.**—C.A.K. (Marple Bridge).

**Q.**—I have a lot of accumulator acid which is 1.250 sp. g., this I want to make into 1.240 sp. g., 1.220 sp. g. and 1.200 sp. g. How much distilled water must I add to a pint of 1.250 sp. g. to make each of the different strengths?

**A.**—We would refer you to our handbook, No. 1, on "Small Accumulators," where information is given which will enable you to compute the specific gravity of an acid yourself.

The following will, however, answer your immediate needs:—

Take 1 pint (20 fluid ozs.) of 1.25 sp. g. and add ¾ fluid oz. of distilled water, and it becomes 1.24.

Take the first quantity given of 1.25 sp. g. and add 3 fluid ozs. of distilled water, and it becomes 1.22 sp. g.

Take the first quantity given of 1.25 sp. g. and add just under 5 fluid ozs. of distilled water, and it becomes 1.2 sp. g.

The above quantities are approximate, but should be near enough. We suggest, however, that you use a graduated acidometer and add water slowly, stirring, until it reads the required sp. g. when cold.

**6,989.—Removing Surplus Metal for Toolholder.**—C.E. (Shropshire).

**Q.**—I have a piece of round mild steel 4 in. diameter by 3½ in. long, which I wish to turn to the dimensions given for the tool post described by F. A. Leete in the March 22nd, 1934, issue of THE MODEL ENGINEER. The metal to be removed involves a lot of heavy work on a pedal driven lathe. Could you suggest a quicker method, than by reducing the whole of the surplus metal to steel turnings. Perhaps Mr. Leete would say if any special method or tool, was used in the case of his exhibit at the 1935 "M.E." exhibition.

**A.**—The only method we can advise is for you to hacksaw the metal out with two central down cuts 1½ in. apart, and then two radial cuts ½ in. in from the other end, so removing bodily two wings. The remaining wings will be similarly removed, but are only 1½ in. across for the cutting. If now it is found heavy work turning off the corners, they can be removed by supplementary slicing down at an angle of 45 deg. to the other cuts, and will also be 1½ in. apart. This involves a good deal of hacksawing, however.

A much more practical way is to produce the stem from a piece of 1½ in. metal 3½ in. long, and the 4 in. flange from a steel blank disc which could be purchased from stock. The stem is then turned down to about 1 in. at the 1½ in. end, and screwcut and fitted to a drilled bored and screwcut hole in the disc.

**6,784.—Sizes of Steps on Lathe Treadle Wheel.**—J.H.B. (Chesterfield).

**Q.**—I am fixing a treadle on my 5 in. Buck and Hickman Lathe, and there are a few details about which I would like a little advice.

The sizes of the 3-speed cone are 6½ in., 4⅞ in., and 3¼ in., 1½ in. wide. Could you advise me what diameter the steps will be in the treadle wheel?

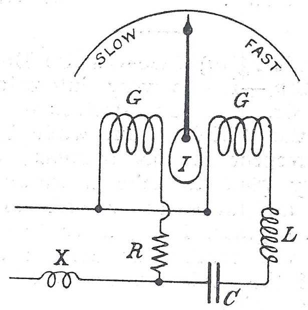
**A.**—The mean single speed of your lathe will be about 240 r.p.m., and a normal treadle speed about 80 per minute. The middle treadle wheel will then be three times the diameter of the middle cone, or $3 \times 4\frac{7}{8} =$ say, 15 inches.

The difference in diameters of cones is 1⅝ in., and the difference in diameters of treadle cones to keep constant belt length will be about ⅝ of this, or 1 in. nearly enough. Thus the three treadle cones come out at 16, 15 and 14 inches. This is only approximate, as the exact calculations depend on the distance apart of the mandrel and treadle centre. See an article on this subject in THE MODEL ENGINEER, of November 29th, 1928.

**6,985.—Details of Frequency Meters.**—J.G.S. (Durham).

**Q.**—Is there an instrument which will indicate frequency (power, audio, or radio) by means of a pointer traversing a graduated dial?

**A.**—Many types of frequency meters are on the market, some of the "vibration" type, and others of the "deflectional" type. The vibration type consists of a row of metal reeds of various widths or thicknesses, varying in length and loaded at one end, each one being adjusted to respond to one particular vibration rate. The heads of the reeds are bent at right angles and painted white, and are exposed through a slot in a scale. They are operated by an alternating current magnet, the particular frequency of the alternating flux being taken up by the frequency of the reed nearest in tune with it; the reed then vibrates so strongly that it almost disappears from view on the scale. Such instruments are independent of wave form, but as a rule the deflectional type is not. Deflectional type frequency meters generally take the form of circuit shown in the diagram. The operating principle is that there are two voltmeter coils G G acting against one




**Circuit Diagram of a Deflectional type Frequency Meter.**

another on the moving iron armature I. One coil is connected inductively through L to the line, and the other non-inductively. If at any particular frequency the pulls are balanced, any decrease in frequency will increase the current in one coil while leaving the other unaltered, so that the armature I with its pointer will be pulled over to that side. In the diagram, X is a highly inductive reactance, and R a non-inductive resistance. Sometimes a condenser C is added. There are also dynamometer-type frequency meters, and induction-type frequency meters, each of which gives deflectional readings on a pointer over a scale. Audio and Radio frequencies are measured by totally different methods. The "Test Oscillator" of the Western Electrical Instrument Co., Kingston By-pass, Surbiton, Surrey, gives a means of dealing with frequencies between 100 kilocycles and 3,000 kilocycles, but it is an expensive instrument.

**6,973.—Rectifying A.C. with Synchronized Commutator.**—W.J. (Sheffield).

**Q.**—It is desired to obtain a supply of direct current at 30 V 2 A for operating models, as cheaply as possible.

**A.**—The description of the method you propose of rectifying your a.c. input is quite practicable in theory, but it is doubtful whether it would be any cheaper to construct than to purchase a Westinghouse copper-oxide "dry" rectifier. The latter would have no moving parts, require no attention, and presents no difficulty in starting up. So far as your proposal is concerned, this is no more than the usual 2-part rectifying commutator with two interleaved segments attached to the winding of an H-type armature, the latter running in a permanent magnet field, so that when run up to synchronous speed (at 300 r.p.m. for a 50 cycle circuit), it would fall into step with the a.c. supply taken through the two brushes bearing on the uninterrupted portions of the commutator. The two middle portions which interleave, change the connection automatically twice every revolution to another pair of brushes placed on this track, the result being interrupted unidirectional current, or what is usually termed pulsating d.c. Your motor armature will have to be wound suitably for full voltage of the a.c. supply, and you must allow sufficient power to overcome the running friction of all four brushes, which will be considerable. It is understood that you intend starting up the rectifier by applying a battery to the middle pair of brushes, and switching off when the motor has run up to synchronous speed. It may not prove to be quite so simple a matter as it sounds, but perhaps you could fit an automatic centrifugal switch to open the battery circuit at the appropriate moment. All things considered, we are of the opinion that a metal rectifier would be more satisfactory and reliable.

## A Guide to Engineering and Technical Careers.

We have received from the National Institute of Engineering a 92-page prospectus of the various courses in correspondence instruction, which they offer to those desiring to enter the different branches of engineering and technical employment, or to improve the positions they have already attained. The courses cover a very wide range of technical study, including preparation for the examinations of the leading civil, mechanical, and electrical engineering institutions, building and sanitary engineering, automobile and aeronautical engineering, Civil Service and municipal technical appointments, draughtsmanship, and preparation for general educational examinations. Particulars of the principal examinations and appointments are given, and a syllabus of the studies required is set out in each case. We note with interest that special courses in radio and television, and "talkie" picture technics, are included in the very complete series of courses offered to the student who is seeking an up-to-date career. The moderate tuition fees are payable by instalments if desired. Copies of this prospectus may be obtained by any "M.E." reader on application to the National Institute of Engineering, Staple Inn Buildings, High Holborn, London, W.C.1.

# PRACTICAL LETTERS from OUR READERS

## The "Churchward Touch."

DEAR SIR,— Goaded on by the letter signed "Reedsmere" in your March 26th issue, and your editorial comments in the April 2nd issue, I trust I may be permitted to add a few comments of my own.

"Reedsmere's" letter suggests that he is a close observer of locomotive performance on the L.M. and S. Railway.

Conversations with enginemen often yield some surprising results; and, almost anywhere one will discover that any one type of locomotive is well-liked by some of the men, and heartily disliked by others. But, since "Reedsmere" has referred particularly to the L.M.S.R., he may be interested to learn of my own observations, made during a long period of frequent observations on the main lines of both the Western and the Midland divisions.

Just prior to the time when the present Chief Mechanical Engineer took office, the punning epithet applied, by the men, to the L.M.S. locomotives generally, was clearly reflected in the poor standard of performance met with. Time-keeping was not good, on the whole, even by the best express trains. The only bright spot was the magnificent work done by the 4-4-0 compounds on the Midland division; but, the same engines on the Western division, seldom, if ever, did any good, at that time—and, moreover, they were frankly detested by the Western men, though just as frankly loved by the Midland men.

At the same time, the work of the "Royal Scots" had fallen to a very low ebb for such engines; and they were being handsomely beaten by the so-called, and smaller, "Baby Scots," which could, usually, be relied upon to give us a good run.

Some six to nine months later, a considerable change took place, and the better standard of locomotive work, which then set in, has been maintained ever since, in spite of all the adverse criticism that one hears levelled against the G.W.R. influences which have become apparent in all the later L.M.S. locomotives. Late running, in all ordinary circumstances, is now almost unknown; and we must not overlook the fact that, in the meantime, most of the main line schedules have been very much speeded up.

In short, it is perfectly apparent to all who care to notice it, that what we have come to regard as the "G.W.R." standard of locomotive work during the past thirty years, has, at last, become the standard on other lines as well—the L.M.S. in particular. I fancy that, to-day, a G.W.R. "Castle" would be hard put to it to beat her competitor in an "exchange" with a L.M.S.R. "Royal Scot," "Baby Scot," or one of the latest "5-XP" 3-cylinder engines, all of which, in my experience have given ample proof of their having been imbued with a considerable modicum of the "Churchward touch."

Maybe that, as your editorial comments seem to suggest, the standard of maintenance has not yet risen to the occasion. But it will! It *must*, if the great improvement in performance is to continue.

I, for one, shall be very surprised if, when the L.M.S. footplate staff have become *thoroughly* used to the engines, the "Churchward touch" is not fully appreciated, as it should be, provided that maintenance can be properly adapted to meet the new conditions.

Yours faithfully,
"CHURCHWARDIAN."

London, W.C.1.

## Non-marring Tools.

DEAR SIR,—Re non-marring tool, under "Workshop Hints and Gadgets," in the March 19th issue of the "M.E." Messrs. Walworth, Ltd., of London, S.E., market a tool and a vice for holding and turning plated or finished work, but instead of leather, their tools have a webb strap.

Yours faithfully,
London, S.W.20. D. NICHOLSON.

## Supercharging Two-Stroke Engines.

DEAR SIR,—I was very interested in the letter by Mr. D. H. Chaddock in the April 2nd issue of the "M.E.," but while I have the greatest respect for his opinions, and have been very glad to take advantage of his valuable assistance in several experiments with I.C. engines, I beg leave to differ with some of the conclusions arrived at in his survey of the problems associated with this particular subject.

"Supercharging" is, like many other technical terms, somewhat loosely applied to any method which supplements the normal process of induction, and though it is usual to consider it as a means of supplying the cylinder with a greater charge than it will normally hold at atmospheric pressure, it may be used with quite substantial practical advantage to remedy the deficiency of an engine to properly fill its own cylinder; in other words, to improve volumetric efficiency or "breathing power" at volumes *below* 100 per cent. of displacement. One may consider it as analagous to administering artificial respiration or oxygen treatment to a person whose lungs, for some reason or other, are unable to function with proper efficiency.

The volumetric efficiency of the usual type of two-stroke engine is very low, particularly at high speeds; this includes even such engines as are highly tuned and capable of power output comparable with that of the best four-stroke engines. This is obvious when one considers that if the two-stroke consumed an equal charge per cycle to that of a four-stroke engine of the same volume at the same speed, it would inevitably develop twice the horse power; probably more, if one considers the mechanical efficiency of the "valveless" engine against that of an engine having to expend a great deal of power in driving its

valve gear. The latter type of engine, however, scores by having a much more efficient charging pump (its own cylinder) than the two-stroke employing crankcase charging.

It is my firm belief that the only really serious limitation of the two-stroke engine in respect of power production, as such, lies in this inherent inefficiency in charging; why not, then, expend a proportion of power comparable to what is used by the four-stroke engine in driving its valves, to put a greater charge into its cylinder? In actual practice it can easily be proved that quite a mild "boost" to the induction on a two-stroke engine will make an enormous difference to its power output. Instead of hitching one's waggon to a star and supercharging to two atmospheres, as suggested by Mr. Chaddock, one might with advantage try to get something like *one* atmosphere into the cylinder!

I have several times referred to the utter impossibility of supercharging the ordinary piston-port controlled two-stroke engine above atmospheric pressure, owing to the fact that the high pressure charge would be blown out of the open exhaust port; but supercharging *below* 100 per cent. volumetric efficiency is quite practicable, and has been very effectively employed, though it would be better to design an engine so as to positively prevent wastage of the charge.

Mr. Chaddock considers only the rotary type of blower as a means of supercharging a two-stroke engine, but there are other methods, and in an experimental design of engine in which I have been interested for some years, very promising results in respect of brake mean effective pressure and fuel efficiency have been obtained by the use of a piston blower. This is a comparatively large engine, but I hope some day to be able to reproduce its principles in a 15 or 30 c.c. engine.

One word of warning, however, to the experimenter who may be inspired by the optimistic note of this letter; new ideas always introduce new problems, and it is probable that getting the extra charge into the cylinder may be the least of all the difficulties connected with supercharging a two-stroke engine. Even an "aspirated" or natural-induction two-stroke can give one some nasty problems in lubrication, internal cooling, and sparking plug design when it begins to develop a spot of power, and these troubles, one can be sure, will not be in any way diminished by supercharging. But the whole problem is a most intriguing one, and I wish the best of luck to anyone with the courage and initiative to tackle it wholeheartedly; I only wish I had the time and facilities to do so myself!

Yours faithfully,
EDGAR T. WESTBURY.
London, S.W.

### The "M.E." Undertype Engine.

DEAR SIR,—I see a letter from Mr. P. Wilson in the March 12 issue of THE MODEL ENGINEER, regarding the large Undertype Engine described in the "M.E." for 1903. Messrs. Bassett-Lowke have all the patterns for this engine, as I have recently had a set from them, both the cast iron and brass castings. Mr. T. Hampson, of Manchester, exhibited one of these engines at the last Hobbies Show in Manchester, and he very kindly supplied me with a set of blue prints for the job. I should not omit the centre bearing in building up this engine, as the flywheel overhangs and is, I think, in keeping with actual practice.

Yours faithfully,
Stalybridge. BENJ. H. WAINWRIGHT.

### Traction Engine Locomotives.

DEAR SIR,—In your issue of 26th March, Mr. Solomon mentions a "locomotive of traction engine type," to be seen on the sidings of Messrs. Hall and Co., of East Croydon. The following particulars of this unusual locomotive may be of interest. It is an 0-4-0 tank, built by J. & H. McLaren, Ltd., of Leeds, the works number being 1547 and being No. 9 in Hall and Co.'s stock. It is of the two-cylinder compound type, the cylinders being mounted on top of the boiler.

Mr. Solomon states that this locomotive was in use for a long period some years ago. This is, however, incorrect, as it is still at work in East Croydon yard.

Yours faithfully,
London, S.E.19. WM. C. F. WHEELER.

## Institutions and Societies.

### The Society of Model and Experimental Engineers.

Meetings. At Caxton Hall, Westminster, at 7.0 p.m.

Friday, May 8th. Competition, Track and Model Night. Do not forget the prize of £1 offered by our President, Mr. T. N. Gilbert, for the best display of work on this evening.

Wednesday, May 27th. A lecture, illustrated by films, will be given dealing with various aspects of Acetylene Welding and Cutting. Among the subjects dealt with will be the following: Oxy-acetylene Welding in Aircraft Construction, in Automobile Construction, Gas Mains and Miscellaneous Applications.

Workshop. Monday, April 27th. Demonstration on Screwcutting by R. W. Gorrod (member).

Whole Day Visit. The whole day visit this year will be to the works of Messrs. Crompton Parkinson and Co., at Chelmsford. It will take place on Wednesday, July 15th. Further particulars in due course.

Secretary: R. W. WRIGHT, 202, Lavender Hill, Enfield, Middlesex.

### Croydon Society of Model Engineers.

The next meeting of the above Society will be held on May 4th, at 8 p.m., at Clyde Hall, Clyde Road, Addiscombe, and will be a "Discussion Night." New members invited.

Hon. Secretary and Treasurer, H. W. CLEMENTS, "Olivedene," Coulsdon Road, Old Coulsdon.

### Finchley Model Engineers' Society.

A most interesting lecture was given last month to the above Society by Mr. Drury, of the General Railway Signal Co., Ltd., on "Signals and Signalling," ably assisted by our lanternist, Mr. Randell. Fixtures for May are as follows: May 6th, Track Night. May 13th, Lecture by Mr. W. Dennis, of the Cape Asbestos Co., Ltd., on "Asbestos," and its uses. May 20th, Construction Night. May 27th, Track Night. All the above will take place at Avenue House, East End Road, Church End, Finchley, N.3. There is also a Workshop Night at Messrs. Percy and Co's. Works, Oaklands Road, Cricklewood, on May 7th.

Further particulars from the Hon. Secretary, S. C. PRITCHARD, "Bishopswood," The Bishop's Avenue, East Finchley, N.2.

### The Kent Model Engineering Society.

The next meeting of the above Society will be held on Friday, April 24th, at 8 p.m., at Sportsbank Hall, Catford, S.E.6; this will be a Discussion Night, when ten minute talks on various model engineering subjects will be given by different members.

On May 5th there will be a practical demonstration on "Brazing and Hard Soldering," by Messrs. Biffen; these two members will demonstrate the ease of joining metals when one knows how.

There are a number of mid-week and week-end visits arranged for the coming months, and those interested are invited to write to the Secretary, who will be pleased to furnish full particulars of the Society.

Hon. Secretary, W. R. COOK, 103, Engleheart Road, S.E.6.

### The Bradford and District Model Power Boat Club.

On Saturday, April 4th, the Steering Competition for the "Foster" Steering Challenge Trophy was held in Bradford Moor Park. There were only six entries, and a cross wind made straight running difficult, particularly for superstructure boats. The winner was Mr. Kenneth Dalby, with "Billy Boy," a petrol-driven boat built by Mr. W. Griffiths. "Billy Boy" scored 45 points, and the runner-up was "Hawk," a petrol-driven cabin cruiser built and sailed by Mr. Griffiths. A meritorious performance was shown by an un-named flash steam driven semi-hydroplane, built by Mr. W. Payne, which had not been previously tried. This trophy is competed for half yearly in April and October. It was previously held by "Hawk."

Temporary Hon. Secretary, EDNA WATMOUGH, First Avenue, Bradford Moor.

### Manchester Society of Model and Experimental Engineers.

The next meeting of the above Society will be on Friday, April 24th, at the Manchester Schools of Technology, Sackville Street, Manchester, at 8 o'clock.

Hon. Secretary and Treasurer, W. E. WOOD, 20, Albert Place, Longsight, Manchester, 13.

### York and District Model Engineering Society.

The next meeting will be held on May 1st, at 7.30 p.m. in the "Bay Horse" Hotel, Monkgate. Will all members please bring something along and give a few words on same.

If any member has something that has been discarded or is surplus and might be of use to others, bring it along and let's have a jumble sale or mock auction.

Hon. Secretary, W. SHEARMAN, JNR., 28, Terry Street, York.

### West London Model Power Boat Club.

The first event of the season was held on Sunday morning, April the 5th, on the home waters, Round Pond, Kensington Gardens, and took the form of a Steering Competition. Unfortunately, the weather was somewhat wintery, and the presence of a strong wind made steering well nigh impossible, so that the result was not unexpected. Of the eleven entries, only two boats managed to score any points, and the event ended with the final position of a tie between Mr. W. Butler and Mr. G. E. Hillman.

The Club are now in possession of a very fine silver trophy presented by their Vice-President, Councillor R. C. D. Jenkins, and the Committee, at their next meeting, will decide the event for which the trophy will be competed.

Hon. Secretary, F. H. LAMBERT, 60, Hogarth Road, Earls Court, S.W.5.

## Notices.

The Editor invites correspondence and original contributions on all small power engineering and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. Unless remuneration is specially asked for, it will be assumed that the contribution is offered in the general interest. All MSS. should be accompanied by a stamped envelope addressed for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall and Co., Ltd., 13-16, Fisher Street, London, W.C.1. Annual Subscription, £1 1s. 8d., post free, to all parts of the world. Half-yearly bound volumes, 11s. 9d., post free.

All correspondence relating to Advertisements and deposits to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer," 13-16, Fisher Street, W.C.1.

## Contents.

*The asterisk (*) denotes that the subject is illustrated.*

# SALES AND WANTS

## EVERYBODY'S MARKET

## ENGINEERING ELECTRICAL for SCIENTIFIC GOODS

*Advertisements are inserted in these columns at the rate of* **One Penny** *per word; minimum charge for advertisement,* **One Shilling.** *Single letters or figures are charged as words, and a compound word as two words. The advertiser's name and address are charged for.*

**Advertisers who wish to separate** *their announcements into distinct paragraphs must have not less than 20 words in any one paragraph followed by the word "Below"—which is charged for.*

**"Box" replies,** *care of these offices, are charged 6d. extra to cover postages. The following words must appear at end of advertisement: "Box——, 'Model Engineer' Offices," for which usual rate will be charged. (Advertisers need not include our full address.)* **When replying to a "Box No." advt.** *address your envelope: Advertiser, Box——, "The Model Engineer," 13-16, Fisher Street, London, W.C.1.*

**All advertisements in these columns must be prepaid,** *and remittances should be made by Postal Orders or Stamps, and sent to the Advertisement Manager, "The Model Engineer," 13-16, Fisher Street, London, W.C.1.*

*Please state under which Classified Heading you wish your advertisement to appear; the classifications are as follows:—*

**General, Models, Wireless, Motoring, Tools, Engines, Electrical, Business, Wanted.**

*Advertisers are requested to send in their announcements as early in the week as possible, as although we accept advertisements up till the first post on Friday preceding the date of issue,* **we cannot guarantee the insertion of those arriving on this day.** *Telephone:* **Holb.: 3818-3819.**

### OUR DEPOSIT SYSTEM.

*We will receive from intending purchasers the purchase money of any article advertised or sold by our advertisers, and will acknowledge its receipt to both the Depositor and the Vendor, whose full names and addresses must be given. Unless otherwise arranged beforehand between the parties, it is understood that all goods are sent on approval, and that each person pays carriage one way if the goods are returned. The deposit is retained by us until we are advised of the completion of the purchase, or of the articles having been returned and accepted. In addition to the amount of the deposit, a fee of 1/- for the sum of £1 and under, and 1/6 for amounts in excess of £1, to cover postage, etc., must be remitted at the same time, and sent to the Advertisement Manager, "The Model Engineer," 13-16, Fisher Street, London, W.C.1. In cases of persons not resident within the United Kingdom, double fees are charged.*

*The amount of the deposit must be sent either by Postal Order or Registered Letter.* **(Cheques cannot be accepted.)**

**The fee mentioned above should be sent in stamps or by Postal Order as a separate amount.**

*In cases of exchange, money to the value of the article should be deposited by each party.* **We cannot receive the articles themselves.**

## General

**Watch Repairers.** Send 3d. for new enlarged list of Tools and Material for Watches, Clocks and Gramophones, also Watches, Clocks and Clock Movements. Our 5s. box of watch parts will save pounds, sample 1s. Watch Repairs guaranteed and fully insured in transit.—Blakiston & Co., Ainsdale, Southport.

**Cheap Printing.** 1,000 Billheads, 3s. 6d. Samples free.—Creteway Press (22), Buxted, Sussex.

**"Practical Sheet and Plate Metal Work."** By E. A. Atkins, M.I.Mech.E. For the use of boiler-makers, braziers, coppersmiths, iron-workers, plumbers, metal and zinc workers, smiths, etc. Patterns are shown set out as they would be in the workshop with hints as to allowances for joints, wiring, and notches, bending up, and the use of tools. Acetylene welding, annealing, etc., are fully treated of in this book, 7s. 6d.; post free 8s. 3d.—Percival Marshall & Co., Ltd., 13-16, Fisher Street, London, W.C.1.

**Small Turned Screws, Nuts and Washers.** Assorted gross B.A., brass 2s., steel 2s. 6d. Whitworth, brass 3s., steel 2s. 6d. List and samples 2d. Trade supplied.—J. H. Bennett, Station Road, Willesden Junction, N.W.10.

**Reduced Prices: Eureka Improved Air** Compressors. Castings and Drawings from 9s. per set. Photo 3d.—Poyser, Peck's Hill, Mansfield.

**"Maxspray" Electric Paint Spray Plants,** £5 5s. complete.—John M. E. Steel, Bingley.

**"Machine Shop Companion."** Splendid book, 100 illustrates, post free 2s. 3d. (abroad 2s. 6d.).—Bentley's Publishing Company (Dept. M.E.), Halifax, Yorks.

**Verette Pocket Microscope,** 7s. 6d.; Microscopes, Prism Binoculars bought, sold, exchanged, repaired.—Pullon, 128, Eastcombe Avenue, S.E.7.

**Dynamo, 40 V 12 A,** good charging machine, 45s.; Capel 3 h.p. Petrol Engine, governor, in good order, but cracked water jacket, 20s.; Petter Paraffin Engine, 3 h.p., cylinder reground, new piston and rings fitted, in fine order, can be seen working, £9.—Morse, Bramlands Lane, Woodmancote, Henfield.

**No Insurance** for burnt books, deeds, etc.!! "Ajax" Safes protect them.—Greenwood, Arnside Road, Southport.

**Steel Tubing, Cold Drawn,** 3/16" to 4¼", 1/32" to ½" thick, for flash boilers, etc. Please say the lengths you cut to.—F. C. Cotes, 28, Church Lane, Brentford, Middlesex.

**Air Compressors.** New patent, 25s.; Super Spray Guns, 17s. 6d. Complete plants.—John M. E. Steel, Bingley.

**Tilting Table,** 12" × 9" × 4½", 3 tee slots, swivels 35 degrees each way, graduated, new and unused, £4 5s.—Kyle, 23, Teesdale Avenue, Isleworth, Middlesex.

**Locomotive Paperweights Wanted** (No. L.N.E.R.).—J. H. Wright, Micklethwaite, near Bingley.

**1 h.p. Petrol Engine, £3;** 25 V Dynamo, £1; Meccano, £1.—Knight, 50, Empingham Road, Stamford.

**Clearance Bargains,** please send for list, post free.—Queen's Engineering, 60, Queen's Road, Battersea, S.W.8.

**"Fishponds and Aquaria,"** by Rosslyn Mannering, with eight plates. Containing full details of how to make the fishpond, the stocking of the pond, breeding, pests and diseases, tropical and untropical fish and an extremely valuable chapter on "Don'ts for Aquarists." 1s. 6d., postage 3d.—The Publishing Department, Percival Marshall & Co., Ltd., 13-16, Fisher Street, W.C.1.

**Bright Mild Steel Rod,** 3' lengths, 2 each 3/16", ¼", 1 each 5/16", ⅜", ½" dia., 21' for 2s. 6d.; Silver Steel, 1 doz. 13" lengths, 1/16"-¼" dia., 2s. All post free.—Parker's, 84, Northgate, Wakefield.

**Agate and Other Stones** cut for Industrial Purposes.—King, Lapidary, 1, Albemarle Street, E.C.1. Phone, Clerkenwell 6335.

**"M.E." Hexagon Head Screws,** "Landite" Silver Solder, try sample shilling's worth, either lot.—30, Highfield Road, Doncaster.

**"Workshop Arithmetic."** Signs and abbreviations; decimals and duo-decimals; square root, cube root, etc.; the metric system; simple workshop formulæ explained; mensuration; calculating quantities; how to read and plot a graph; how to read the micrometer and vernier; speeds of machinery; pulley, belt and horse-power calculations; calculations in gear wheels; the slide rule explained; the dimensions of electrical units, 1s. 6d.; post free 1s. 9d.—Percival Marshall & Co., Ltd., 13-16, Fisher Street, London, W.C.1.

**Sliding Die Holders,** No. 1 Morse Taper, takes 13/16" and 1" dies in same holder, 5s. 6d. post free (listed 15s.).—Below.

**Aero Engines,** 15 c.c., new, complete, with propeller, carburettor, plug, contact breaker, light alloy, best made, £2 10s. each, limited stock. Ditto Marine, with flywheel. Stamped envelope, appointment.—80, Ridgeview Road, N.20.

## Models

**Boilers in Steel or Copper,** all types and sizes. Locomotive Boilers from ½" scale made to fit your frames, flanged plates, supplied copper or steel.—Goodhand, Marlborough Road, Gillingham, Kent.

**Why Not Be The Proud Owner of a High** Pressure Locomotive by E. J. Cooke. Accurate in detail, scale and workmanship. Get your next model from the man who specialises in the production of real miniature locomotives. Full Catalogue of Complete Locomotives, Castings, Parts, etc., 6d.—"Ejaycee" Models, E. J. Cooke, 66a, George Street, Hastings.

**"OO" Gauge Correct Section Brass** Track and Points on brass sleepers, ⅝" apart, any radius or straight, in 3' lengths or less, 10d. per foot, supplied by return, post free. Send for List and Free Sample. Rail or Sleepers separately.—T. and M. Products, 1, West Street, Leigh-on-Sea, Essex.

**Model Cargo Steamer,** fitted "Stuart" compound twin engine, boiler, pumps, etc. For particulars, or seen.—Greener, 20, Countess Avenue, Whitley Bay.

**Stuart B.B. Engine,** with bed, steampipe, boiler, 35s.; Nautilus Electric Motor, new, £1.—34, Bury Road, Alverstoke, Hants.

**Dozen 2' Steam Speed Boats,** Honduras mahogany hulls, Stuart Turner engines, £3 each. S.A.E. Full particulars.—Esprey, The Springs, Brereton Staffs.

**Steam Tug,** 3' 8", **Diploma "M.E."** Exhibition, 1932, in good condition, £5.—Bradford, 19, South Park Crescent, Catford.

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**Brand New G.E.C. Racing Motor** and Accumulator, cost 24s., will exchange for Small Steam Launch Engine.—LAMBERT, 9, Seaford Buildings, Rotherhithe.

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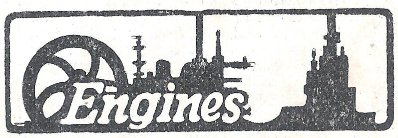


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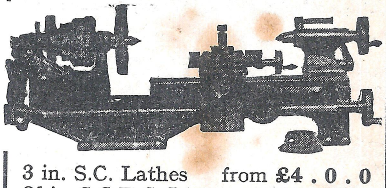

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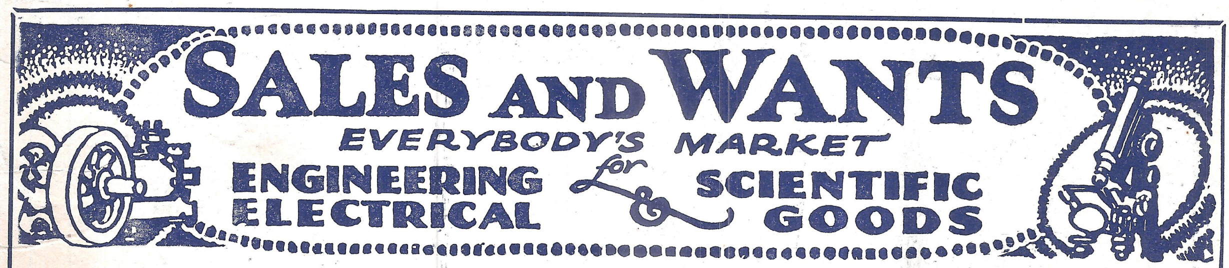


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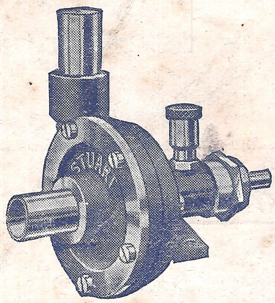


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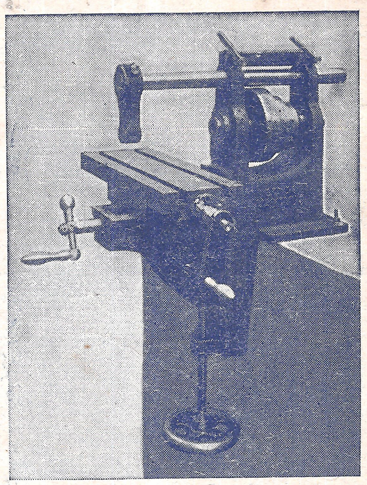

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